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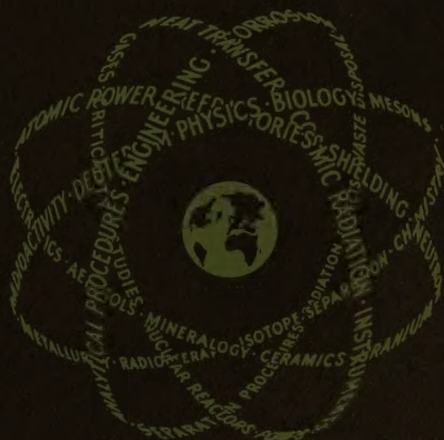
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Abstracts are arranged according to broad subject categories as illustrated by the Contents (page iii). A new system of subject categories has been introduced in Volume 14.

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CORRECTIONS

NSA Vol. 10, No. 2 p. 80. In abstract 649, Kolloid. Zhur. 17, 579-86(1955), should be Kolloid. Zhur. 17, 379-89(1955).

NSA Vol. 10, No. 3, p. 172. In abstract 1397, personal author W. E. Dyrkacz should be W. W. Dyrkacz.

NSA Vol. 10, No. 3, p. 190. In abstract 1552, personal author R. E. Huaschen should be R. E. Hueschen.

NSA Vol. 11, No. 19, p. 1176. In abstract 10696, Uspekhi Fiz. Nauk 52, should be Uspekhi Fiz. Nauk 62.

NSA Vol. 12, No. 1, p. 20. In abstract 179, Zhur. Neorg. Khim. 3 should be Zhur. Neorg. Khim. 1.

NSA Vol. 12, No. 21, p. 1907. In abstract 15352, in title: ... and Their Use As Analytical Masking Agents. Should be ...and Their Use As Analytical Masking Agents.

NSA Vol. 12, No. 22, p. 2036. In abstract 16350, Priroda 2, should be Priroda 47, No. 2.

NSA Vol. 13, No. 23, p. 2793. In abstract 20819, Fiziol. Zhur. SSSR. 4, should be Fiziol. Zhur. Akad. Nauk Ukr. R.S.R. 4, 814-20(1958).

NSA Vol. 14, No. 5, p. 588. In abstract 4598, line 31 of abstract ...N-C₄H₁₀ with WF₃, should read ...n-C₄H₁₀ with NF₃...

NSA Vol. 14, No. 5, p. 588. In abstract 4598, line 32 ... WF₃ should be ...NF₃...

NUCLEAR SCIENCE ABSTRACTS

Volume 14 Number 15

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GENERAL AND MISCELLANEOUS

14611 TEI-756

Geological Survey, Washington, D. C.
SOME EFFECTS OF UNDERGROUND NUCLEAR EXPLOSIONS ON TUFF. Verl R. Wilmarth. Dec. 1959. 36p. OTS.

Presented at the Geological Society of America Annual Meeting, Pittsburgh, Penna., November 2, 1959.

The effects of the Rainier, 1.7 kt at a scaled depth of 690 ft; Logan, 5 at 482; and Blanca, 19 at 319, explosions on tuff were determined from observations and measurements on the surface and in drill holes and tunnels. Rock slides above the explosion points were the most obvious surface effects. Movement took place mainly along preexplosion fractures. Displacements were observed at distances up to 3,000 feet on the surface and up to 2,500 feet in tunnels. Below the Rainier chamber a hemispherical breccia zone about 75 feet in radius was found. The breccia contains angular blocks of tuff in a pulverized matrix which contains droplets and fragments of radioactive glass. The glass contains the bulk of the fission products and seems to be restricted to the breccia zone. Beyond the breccia for a radial distance of at least 110 feet from the chamber, the tuff is minutely fractured and is characterized by low compressive strength, low velocity, and high permeability. One year after the explosion, temperatures greater than 2°C above normal extended 120 feet horizontally and 80 feet vertically from the chamber. Integration of anomalous temperature data indicates that over half the energy in the explosion was in the form of heat. The temperatures probably dropped below the boiling point of water a few hours or days after the explosion because of the rapid transfer of heat by steam through explosion-produced and natural fractures. (auth)

14612 TEI-761

Geological Survey, Washington, D. C.
SEISMIC MEASUREMENTS BY THE U. S. GEOLOGICAL SURVEY DURING THE PRE-GNOME HIGH-EXPLOSIVES TESTS NEAR CARLSBAD, NEW MEXICO. Final Report. P. Edward Byerly, S. W. Stewart, and J. C. Roller. Apr. 1960. 40p., 4 illus. OTS.

The U. S. Geological Survey monitored three high-explosive test shots at the Gnome site during the Pre-Gnome experiments and monitored routine blasting in the potash mine of the Duval Sulphur and Potash Company. The motion in the potash mines near Carlsbad from a shot of 9 kt of TNT at the Gnome site, 46,000 feet from the nearest potash mine, is given. These particle velocities and accelerations are less than those recorded at a distance of 90 feet from a routine 75-pound dynamite blast in a potash mine. (auth)

14613 TID-5766

Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.

FIFTY-FIFTH PROGRESS REPORT THROUGH OCTOBER 31, 1959. Nov. 1, 1959. 133p. Contracts AT(30-1)-2098; NASw-37; NASw-75; and AT(30-1)-905. OTS.

Fission Elements Group. A summary of progress is reported on certain aspects of flame photometry, photometric titrations in nonaqueous media, coulometric generation of sulphydryl reagents and fused salt electrochemistry. Continuing progress is also reported in studies on lower valence states of indium, polarography of silver and mercury complexes, thermometric titrations, irreversible electrode processes, and absorption and luminescence spectra of chelates in gas chromatography. New studies include work on multi-electron electrode reactions, nonaqueous polarography of metals, electrolytic and foam chromatography.

Nuclear Chemistry (Inorganic) Group. Research efforts are reported on physico-chemical studies of ion-exchange and solvent extraction systems, and nuclear chemical studies of the fission process and charged particle reactions. Nuclear Chemistry (Organic) Group. Research is reported on mechanism of substitution of triphenylmethyl halides in benzene. Data on dimerization of acetic acid in benzene and on the complexing constant between acetic acid and tertiary amine in benzene at 25°C are tabulated. The solubilities of methyl halides in water and D₂O at 29.4 and 40.3° were measured. Methyl chloride and methyl bromide were also studied at 49.6°C. Results are presented tabularly.

Other research was conducted on the mechanism of the Cannizzaro reaction, methyl halide ground and transition states in water solution, acid catalysis of methyl fluoride hydrolysis, displacement mechanism in silicon compounds, and selectivity in carbene reaction. Cosmic Ray Group. Activities reported include operation details of the high counting rate meson monitor, large air shower experiments, and polarization of cosmic ray mu-mesons. Discussions of activities of high-energy gamma-ray experiments are also included along with a description of work on plasma probes. High Energy Accelerator Physics Group. An experiment is reported to measure the photo-production of neutral pi-mesons from complex nuclei by 250 Mev gamma rays at forward angles. Data are included on the angular distribution of neutral mesons from calcium, carbon, and lead. Other activities are reported on a study of pi-capture in complex nuclei, single quantum annihilation of positrons, search for a neutral spin one meson in the π mass range, and development of a method of analyzing the angular distributions and polarization of high energy protons. Bubble Chamber Group. Installation and operation of the 15-inch methyl iodide chamber and 20,000 gauss magnet are reported. Effort was also directed toward designing and building hardware to mount a 9-inch propane

chamber inside the magnet with which it will be used.

Linear Accelerator Group. Measurements of the cross sections involved in the photodisintegration of Be^9 at 2.5 to 17 Mev were completed. Data on the reaction processes are included. In other work, neutron spectra at 115 degrees from 17.0 Mev bremsstrahlung were measured for lithium, nitrogen, and fluorine, and from 17.55 Mev bremsstrahlung for oxygen. **Rockefeller Generator Group.** Preliminary trials with the pulsed generator include generator loading, ion source modulation, measurement of burst duration, and lifetime measurements of Sm^{154} first excited state. Other activities include generator modifications, and preparation of experimental equipment. **ONR Generator Group.** Data taken during the period included those on energy levels of silicon isotopes from inelastic proton-scattering. Various other nuclear reactions such as $\text{O}^{16}(\text{p},\alpha)\text{N}^{13}$, $\text{Si}^{30}(\text{p},\alpha)\text{Al}^{27}$, and $\text{Co}^{58}(\text{d},\text{p})\text{Co}^{60}$ were studied, and selenium energy levels were investigated. Data on the levels of Ne^{21} and Ne^{23} are also included along with those of F^{18} . **Radioactivity Group.** Coincidence experiments for measuring nuclear gyromagnetic ratios demonstrated a scheme of measurement which appears to be the most convenient method for conditions in which only part of a larmor period can be followed. Data on time dependence of angular correlations and anisotropy of Hf^{181} , Sm^{152} , Gd^{154} , and Gd^{156} are reported along with data on the linear polarization of gamma rays from Co^{55} . **Cyclotron Group.** Investigation of the anomalous inelastic alpha particle scattering was continued, with emphasis on gamma ray de-excitation studies. **Theoretical Group.** The work of this group was wide-spread, covering topics from general relativity to low range nuclear physics. Problems in meson production were investigated and a general attempt is being made to understand collective vibration in nuclei from a more basic point of view. The work in low-energy nuclear physics was mainly concentrated on the study of collective vibrations and rotations. (For preceding period see AECU-4525.) (J.R.D.)

14614 TID-5928

Holmes and Narver, Inc., Los Angeles.

COMPLETION REPORT PROJECT CHARIOT — PHASE II. PLOWSHARE PROGRAM. 1959-1960. 66p. Contract AT(29-2)-20. (P/C-6-60). OTS.

Project Chariot of Plowshare Operation was established to demonstrate the practicability of creating a deep-water harbor and port facilities by means of nuclear detonations, and to collect scientific information fundamental to future applications. The site chosen was in the Cape Thompson area in northwestern Alaska. Activities are described in establishing a camp capable of supporting 75 men, construction of an airstrip and access roads, and providing transportation at the site and transportation for personnel and materials from Kotzebue to the site. Two cores were drilled to depths of 598 and 1172 feet, respectively. A thermister cable was installed and velocity and thermal logging accomplished. Camp facilities are illustrated photographically. (C.H.)

14615

MANNED NUCLEAR SPACE SYSTEMS. PART I. HIGH-TRUST NUCLEAR SYSTEMS. E. B. Konecni, R. F. Trapp, and M. W. Hunter (Douglas Aircraft Co., Inc., [Santa Monica, Calif.]). *Aero Space Eng.* 19, 34-41(1960) Jan.

The high thrust nuclear system is discussed in the performance of the Martian mission. The assumed mission could be performed, in the minimum energy case, in about 3 years at 70,000 fps impulsive velocity by using the Hohman transfer. A trip of one year would require about 120,000 fps. A method is outlined whereby the mission is

accomplished in about 421 days in a two-stage vehicle of specific impulse $I_{sp} = 1,000$ sec and a ratio of fuel weight to total propulsion system weight $\lambda' = 0.90$. Hydrogen fuel is used with a nuclear reactor. Tankers fired one month before the manned vehicle would arrive two weeks prior to start of return trip of the manned vehicle. The tankers would follow a path which required less energy and would remain in orbit around Mars after furnishing fuel for the manned vehicle's return to earth. The payload of the vehicle is proposed at 55,000 lbs, with sustenance material for the three-man crew and the U^{238} scatter shield using up the larger parts of the payload. The total exposure for the 14-month mission has been kept below 12 rem, i.e., the new maximum permissible dose for one year. (B.O.G.)

14616

ATOMIC INDUSTRY IN GERMANY. Wolfgang D. Müller. *Atomwirtschaft* 5, 149-50(1960) Apr. (In German)

The atomic industry in Germany is based completely on private enterprise. There is no development for the military use of nuclear energy. The principal advantage is that each project must satisfy the economic requirements of industry. (J.S.R.)

14617

STRUCTURE AND DYNAMICS OF THE ATOMIC INDUSTRY. Wolfgang Koeck. *Atomwirtschaft* 5, 151-5(1960) Apr. (In German)

The industrial utilization of nuclear energy has led to completely new technical requirements and to the growth of industries capable of supplying them. The new industry can be divided into the nuclear fuel division, the basic engineering materials division, and the special engineering supply division. The nuclear industry must be able to adapt to new requirements as the needs of the constructor changes. (J.S.R.)

14618

DEMANDS OF THE REACTOR CONSTRUCTOR ON THE MANUFACTURING INDUSTRY. A. Schuller (Allgemeine Elektrizitäts-Gesellschaft, Frankfurt am Main). *Atomwirtschaft* 5, 156(1960) Apr. (In German)

The demands of the designer and the capabilities of the manufacturer are still not coordinated on an economic basis. This results in specifications which are too rigid and then to price increases by the manufacturer. (J.S.R.)

14619

THE FINANCING OF NUCLEAR TECHNOLOGICAL DEVELOPMENT IN GERMANY. Josef Brandl (Bundesministerium für Atomkernenergie und Wasserwirtschaft, Bad Godesberg, Ger.). *Atomwirtschaft* 5, 162-6(1960) Apr. (In German)

The development and utilization of nuclear technology is the task of private enterprise. The state only gives aid when the capacity of the firms concerned is exceeded by some particular projects. (J.S.R.)

14620

New Zealand. Dept. of Scientific and Industrial Research, Wellington.

SYMPOSIUM ON NUCLEAR SCIENCE, HELD AT WELLINGTON, 25 FEBRUARY 1959. Information Series No. 23. 1959. 47p.

A publication containing papers presented at a symposium on nuclear science is presented. The papers were given by members of the New Zealand delegation to the International Conference in 1958. Descriptions of various nuclear establishments visited by delegates while they were abroad are included along with displays of work being done by various countries. An outline of New Zealand's nuclear program is also given. (J.R.D.)

14621

Atomic Energy Commission, Washington, D. C.
RADIOISOTOPES IN SCIENCE AND INDUSTRY. Jan. 1960.
 188p. \$1.25(GPO).

The contributions of radioisotopes to the sciences, agriculture, medicine, and industry are reviewed briefly. Separate chapters deal with the progress of research in agriculture and other biological fields; the applications of radioisotopes and radiation to medical diagnosis and therapy; the benefits of isotopes in chemical and physical research; examples of existing industrial uses; some problems of industrial development and studies aimed at solving them for broad segments of the economy; the potential of high-intensity radiation in industrial processes; the training program that assists broader uses of radioisotopes; trends in isotope production, distribution, and pricing; and safeguards to health and safety in the use of radioisotopes and radiation. (C.H.)

14622

New York. Office of Atomic Development, Albany.
AN ATOMIC DEVELOPMENT PLAN FOR THE STATE OF NEW YORK. Dec. 1, 1959. 56p.

A review of development plans for the state of New York is presented. Included are discussions of background of nuclear development, present status of atomic energy in the state, possibilities for development, and objectives of the program. A twelve-point development program outline is also included, and various other comments and data are presented in appendices. (auth)

BIOLOGY AND MEDICINE

General and Miscellaneous

14623 AERE-R-3288

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
BIOASSAY OF EXCRETA AND BODY BURDEN OF RADIOACTIVE MATERIALS. Katharine Williams. Mar. 1960. 20p. BIS.

Workers who are employed in handling and preparing open sources of radioactive materials are exposed to the hazard of intake into the body. In the case of natural radioactive substances, the effects on workers are known. With other materials, the likely effects can be deduced from animal experiments. The International Commission on Radiological Protection has recommended maximum permissible body burdens for a number of radioactive isotopes. Where practicable and appropriate, the degree and trend of the retention in the body of a worker exposed to a specific radioactive isotope should be tested as a part of the medical supervision. As with chemically toxic substances, the practice of estimating the urinary excretion of radioactive isotopes is widely employed as part of the normal occupational hygiene control. The advantages and limitations of the method for estimations of amounts retained in the body are discussed. (auth)

14624 COO-220

Utah. Univ., Salt Lake City. Coll. of Medicine.
RESEARCH IN RADIOBIOLOGY. Annual Report of Work in Progress on the Chronic Toxicity Program. Thomas F. Dougherty. Mar. 31, 1960. 228p. Contract AT(11-1)-119. OTS.

Progress is reported in long-term studies on the toxic effects of radioactive heavy metals in dogs. Data are in-

cluded on the effects of injected plutonium, radium, strontium-90, thorium, and lead-212. Topics discussed include the effect of injected radioisotopes on dental tissues, the biochemistry of blood and of serum proteins, dosage determinations, tissue distribution, and pathological effects of internally deposited radioisotopes upon the blood vessels of cortical bone. Improvements in autoradiographic techniques are described. (C.H.)

14625 NYO-2906

Western Reserve Univ., Cleveland. Atomic Energy Medical Research Project.

AN ANALOGUE COMPUTOR FOR THE GENERALIZED THREE-COMPARTMENT MODEL OF TRANSPORT IN BIOLOGICAL SYSTEMS. Earle C. Gregg. Dec. 30, 1959. 25p. Contract W-31-109-eng-78. OTS.

Design criteria are presented for an analog computer for the generalized three-compartment model of transport in biological systems. Applications in tracer studies are discussed. (C.H.)

14626 ORINS-35

Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.
STANDARD-MAN PHANTOMS. R. L. Hayes. Apr. 1960. 15p. OTS.

Descriptions are presented of compartmentalized phantoms to simulate a standard man, an adolescent, and a child. The basic emphasis on the designs is on general utility so that a variety of different dose-measurement techniques can be used on the same phantom. The phantoms have proved useful in depth dose and total energy-absorption measurements for total-body irradiation therapy. (C.H.)

14627 ORO-245

Tennessee. Univ., Oak Ridge. UT-AEC Agricultural Research Lab.
SEMI-ANNUAL PROGRESS REPORT FOR JULY 1, 1959-DECEMBER 31, 1959. Apr. 1960. 57p. Contract AT-40-1-GEN-242. OTS.

Boneless roasts and roasts with bone were obtained from steers dosed orally with calcium-45 and strontium-90. An analysis of cooked meat samples showed that calcium-45 and strontium-89 moved from the bone into the meat and drippings during cooking. Progress is reported in animal metabolism studies using copper-64, phosphorus-32, molybdenum-99, cesium-134, calcium-45, strontium-89, zinc-65, iron-59, selenium-75, and potassium-42. The effectiveness of ion exchange materials for removing cesium-134 and iodine-131 from milk was investigated. Ion exchange treatment of milk did not cause any marked changes in nutritive value. Progress is reported in studies on the influence of stable dietary barium, strontium, and calcium on the uptake of stable strontium and calcium by bone in chicks; the effects of dietary calcium, phosphorus, and vitamin D₃ on the uptake of strontium-89, calcium-45, and phosphorus-32 by bones in chickens; the effects of terephthalic acid on calcium-45 and strontium-89 absorption; the absorption of carbon-14 labeled linoleic acid in chicks; and the effects of radiation on reproductive physiology in farm animals and rats. The status is reviewed of burros and swine which survived gamma-neutron irradiation from an atomic detonation, burros exposed to sublethal doses of gamma radiation five years previously, and burros exposed to neutron-gamma radiation from a bare reactor. Data are included on weight, pathological findings, and physiological response of the animals. The toxicity of radium and strontium was compared in sheep and the LD₅₀ radiation dose was determined for Hereford cattle. Results are summarized from a number of studies on the transmission of radioinduced mutations in plants.

A list is included of publications during the period. (For preceding period see ORO-217.) (C.H.)

14628 TID-5823

Harvard Univ., Boston. Massachusetts Eye and Ear Infirmary.

STUDY OF THE HEALING OF CORNEAL WOUNDS WITH RADIOACTIVE ISOTOPES, WITH SPECIAL REFERENCE TO THE PLASTIC ARTIFICIAL CORNEA. William Stone, Jr. 1960. 13p. Contract AT(30-1)-1905. OTS.

Results are reported from preliminary studies employing phosphorus-32 to trace the incorporation of phosphorus into normal corneas, as well as injured, healing, and plastic disc-implanted corneas. Results indicate that phosphorus-containing components of whole rabbit corneas as well as the corneal epithelium and stroma can be fractionated into the phosphorus-containing components. Results indicate that corneal tissue has an abundant amount of stable phosphorus-containing compounds which could be important in the wound-healing process. (C.H.)

14629 UCRL-8988

California. Univ., Berkeley. Lawrence Radiation Lab. BIOLOGY AND MEDICINE SEMI-ANNUAL REPORT FOR APRIL THROUGH SEPTEMBER 1959. Dec. 1959. 91p. Contract W-7405-eng-48. OTS.

Progress is reported in the following studies: the ultrastructure of cells of yeast, diatoms, and Hela as observed with the electron microscope; the effects of pituitary irradiation on human metastatic mammary carcinoma and certain endocrine-controlled diseases, the response of breast cancer patients to changes in endocrine status, and the excretion of urinary estrogens in patients with advanced metastatic mammary carcinoma; the effects of irradiation on the response of isolated nerve fibers; the effects of radiation on phagocytic activity in the reticuloendothelial system; demonstration of a protective effect of intraperitoneally injected olive oil against radiation injury in mice; the physiological effects of transplantation of homologous tissues; biological effects of internally deposited radioisotopes; the incidence of mammary tumors in astatine-211 injected rats; the metabolism of fatty acids in humans; the pathology of atherosclerosis; coronary blood flow; the effectiveness of human urinary erythropoietin in primates; determinations of protein-bound iodine in blood serum; the role of citric acid in bone physiology and its relationship to calcium metabolism; measurements of radioactivity in man using a whole-body counter; development of an infrared micromethod for serum lipid analysis and methods of gas-phase chromatography employing a strontium-90 radiation detector; the development of a method for the *in vivo* measurement of blood flow to the gastrointestinal tract; investigation of radiation-induced oxidation of aqueous glycine anhydride-oxygen solution and of aqueous protein-oxygen systems; reactions in the radiolysis of aqueous protein systems and in the irradiation of peptides in the solid state. Activities in the fields of radiation detection and protection during the period are summarized. A list is included of reports and papers prepared during the period. (C.H.)

14630 WT-745

School of Aviation Medicine, Randolph AFB, Tex. OCULAR EFFECTS OF THERMAL RADIATION FROM ATOMIC DETONATION—FLASHBLINDNESS AND CHORIORETINAL BURNS. Victor A. Byrnes, D. V. L. Brown, H. W. Rose, and Paul A. Cibis. Nov. 30, 1955. Decl. Dec. 1, 1959. 76p. Project 4.5 of OPERATION UPSHOT-KNOTHOLE. OTS.

A combined infrared absorbing and red transmitting

filter protected individuals from retinal burns and allowed performance of typical visual tasks required of a pilot flying an aircraft within 20 to 60 seconds following the flash of an atomic bomb detonation. Results are included from an experiment using 700 rabbits exposed to six predawn atomic blasts at distances varying from 2 to 42.5 miles. It was found that retinal damage varied with the bomb kilotonnage and diminished with the distance of the animals from the flash. (C.H.)

14631 JPRS-2256

ELIMINATION OF RADIOACTIVE STRONTIUM FROM THE ORGANISM UNDER THE INFLUENCE OF CERTAIN COMPLEX-FORMING COMPOUNDS. O. A. Khomutovskii (Khomutovskiy). Translated from *Fiziol. Zhur. Akad. Nauk Ukr. R.S.S.R.* 5, 670-8(1959). 16p. OTS.

The absorption of the sodium salt of radioactive strontium from the gastrointestinal tract is 54 to 58 per cent of the administered dose in rats. The maximum content of the isotope in the soft tissues was reached in two hours, and in the bones in eight hours. The total amount of Sr^{90} in the osseous tissue upon giving the isotope orally was two times, and in the soft tissues ten times, less than with intraperitoneal administration. With oral administration of Sr^{90} to rats, 60 to 76 per cent of the administered dose is excreted in five days in the urine and feces, which is twice as much as when it is given intraperitoneally. Prevention of absorption of Sr^{90} from the gastrointestinal tract during the course of the first two hours may be achieved with the use of substances which combine with Sr^{90} to form insoluble compounds. With the administration of oxalic acid orally in doses of 0.15 to 0.18 mg per gm body weight within an hour after the oral administration of Sr^{90} , the content of the isotope in the femoral bones of experimental rats is only half that found in control rats. (auth)

14632 JPRS-2504

GENETIC EFFECT OF FREE RADICALS. (Geneticheskii Effekt Svobodnykh Radikalov). N. P. Dubinin, B. N. Sidorov, and N. N. Sokolov. Translated from *Doklady Akad. Nauk S.S.S.R.* 128, 172-5(1959). 14p. OTS.

Experiments are described which involved induction of mutations in the cells of onion rhizomes by chemically produced free radicals in the cells. The study was intended to yield information useful in the study of direct and indirect effects of radiation on cellular structures, particularly chromosomes. The germinated onion seeds were treated with 0.001 M FeSO_4 and then with 0.006 M H_2O_2 , and chromosomal mutations observed. About 24.76% of the cells were observed to be altered by the observation method used. Thus, it was proved that the radicals OH and HO_2 affect the structures of a living cell. (T.R.H.)

14633

A GAMMA RADIATION SOURCE ESPECIALLY ADAPTED TO AGRONOMIC INVESTIGATION. Cesar Gomez Campo. *Bol. inst. nacl. invest. agron. (Madrid)* 19, 135-45(1959) June. (In Spanish)

A Cs-Ba¹³⁷ gamma radiation source is described. Cesium is chosen because of its long half life. A cylindrical shape is achieved by means of a stainless steel hollow canister. This cylinder is prepared to be used for both inward and outward irradiation. In this way, a wide range of dose rates (from 0 to 125,000 r/h) is available. Samples can receive acute doses inside the canister. Also, the source can be taken out for irradiating growing plants with a gamma field. A simple mechanism makes possible this double use. (auth)

14634

COMPARATIVE STUDY OF THE BEHAVIOR OF Sr^{90} AND

Ca⁴⁵ IN THE BLOOD AFTER VASCULAR INJECTION IN THE RAT. M. J. Guilloux and G. Michon (Centre d'Études Nucléaires, Saclay, France). *Compt. rend. soc. biol.* **153**, 1766-9(1959). (In French)

The distribution velocity of strontium and calcium introduced into circulating blood in the rat was studied. Both arterial and venous injections were investigated. The radioactivity of the blood was monitored for five hours. The curves for all types of injections have the same general pattern. After a rapid increase during which the radioisotopes are diffused in the blood, an evolution decomposable into three exponential functions appears. The maximum appears after two minutes with intravenous injection and after three minutes with intraarterial injection. Equilibrium is attained after three hours. From the study it appears that strontium and calcium behave in a very similar, if not identical, manner in the blood. (J.S.R.)

14535

RADIOACTIVE CARBOXYLIC ACIDS OBTAINED BY β -RADIATION FROM A GASEOUS MIXTURE OF n -PENTANE AND C¹⁴O₂. Bianca Aliprandi and Fulvio Cacace (Università, Rome). *Gazz. chim. ital.* **89**, 2268-74(1959). (In Italian)

Radioactive carboxylic acids are obtained by irradiating a gaseous mixture of n -pentane and C¹⁴O₂ with a β -radiation source from Kr⁸⁵. In the saturated monocarboxylic acids containing one to six atoms of carbon, separated by gaseous chromatography, a considerable amount of the initially present radioactivity in carbon dioxide has been found. The relatively high specific activity of the substances which are so obtained shows that this labeling method can be profitably applied in the preparation of organic compounds containing radiocarbon. (auth)

14635

RADIOACTIVE ISOTOPES IN BIOLOGY AND MEDICINE. [PART] II. Johannes Meissner (Forschungsinstitut, Borstel, Ger.). *Kerntechnik* **2**, 126-31(1960) Apr. (In German)

The properties of radioactives which affect the planning, carrying out, and evaluation of tracer studies are reported. In addition to the biochemical reactions which must be followed with the tracers, the selection must be determined from physical factors as half life, type and energy of radiation, specific activity, carrier, and isotope effect. The effect of these factors on the measurement techniques was considered. Regulations for the tracer dose and the measurement magnitudes are given. The applicability of stable isotopes as tracers is discussed. (J.S.R.)

14637

TRITIUM DOSAGE IN A PROPORTIONAL COUNTER. PART II. PREPARATION OF THE SAMPLES. P. S. Ciccarone, G. Thomas, and W. G. Verly (Université, Liège and Centre d'Etude de l'Energie Nucléaire, Brussels). *Nukleonik* **1**, 329-32(1959). (In French)

The organic compound containing tritium is burnt with an oxygen current and the combustion water is transferred *in vacuo* to a tube which contains magnesium turnings; the tube is then sealed and heated to 550°C for 1 hour. The tritium produced by the hydrogen reduction is measured by means of a proportional counter containing methane. Neither the combustion equipment nor the magnesium turnings are the source of hydrogen or of other gas, so that the specific activity measurement of the reducing hydrogen can be used to determine the tritium concentration in the organic compound. The memory effect in the combustion equipment is negligible, and the error made in the whole operation is about 1.5%. (auth)

14638

INFLUENCE OF EXCESSIVE AMOUNTS OF VIT. D₃ ON STRONTIUM-89 METABOLISM IN THE RAT. Frank R. Mraz and James A. Bacon (Univ. of Tennessee-Atomic Energy Commission Agricultural Research Lab., Oak Ridge). *Proc. Soc. Exptl. Biol. Med.* **104**, 1-6(1960) May.

The experiments demonstrated that vitamin D₃ exerted an effect on excretion of strontium-89 by increasing absorption of strontium-89 from the gut, by decreasing fecal and increasing urinary strontium-89 providing either calcium or strontium is present in the diet. The efficiency with which vitamin D₃ exerted this effect was governed by its concentration in the diet and by length of time it was fed before administration of strontium-89. (auth)

14639

VOLUME AND TURNOVER OF BODY WATER IN DIPLODOMYS DESERTI WITH TRITIATED WATER. C. R. Richmond, T. T. Trujillo, and D. W. Martin (Los Alamos Scientific Lab., N. Mex.). *Proc. Soc. Exptl. Biol. Med.* **104**, 9-11(1960) May.

Mean exchangeable body water content, as measured by the tritium water dilution method, was 62.37 \pm 2.16% of the body weight for 20 Kangaroo rats (*D. deserti*). When maintained on a diet of pearled barley only, 2 groups of animals showed mean turnover times for exchangeable body water of 13.9 and 22.1 days. This is much longer than that found in the ordinary white rat and in other mammals and presents an adaptation to a xeric environment. (auth)

14640

METABOLIC BASIS OF CALCIUM AND STRONTIUM DISCRIMINATION: STUDIES WITH SURVIVING INTESTINAL SEGMENTS. R. H. Wasserman (State Univ. Veterinary Coll., Ithaca, N. Y.). *Proc. Soc. Exptl. Biol. Med.* **104**, 92-5(1960) May.

The differential movement of Ca⁴⁵ and Sr⁸⁵ across surviving intestinal segments of the rat was studied. In the duodenal segment, Ca⁴⁵ but not Sr⁸⁵ was transported against a concentration gradient from mucosa to serosa. In the ileal segment, Sr⁸⁵ but not Ca⁴⁵ was transferred against a concentration gradient from serosa to mucosa. Incubation of segments at 0°C under N₂, or in presence of metabolic inhibitors eliminated active transport and eliminated strontium-calcium discrimination. Ca-Sr discrimination under given conditions was dependent upon a metabolically active membrane. (auth)

14641

INCORPORATION OF METHIONINE S³⁵ INTO VARIOUS ENZYMATIC PROTEINS OF MUSCLES. P. D. Dvornikova and V. A. Grigor'eva (Inst. of Biochemistry, Academy of Sciences, Ukrainian SSR, Kiev). *Ukrain. Biokhim. Zhur.* **32**, No. 2, 201-2(1960). (In Ukrainian)

Protein fractions were isolated from cat and rabbit muscles in a pure form, following introduction of S³⁵-activated methionine. Determinations showed regular distributions of the tracer in each isolated fraction. The highest activity was found in phosphorylase; and a somewhat lower activity, in phosphofructokinase. In myogen A (f-0.55), possessing aldolase activity; in the non-crystalline fraction separated by 0.55 to 0.66 saturation ammonium sulfate; and in the dehydrogenase of d-glyceraldehyde phosphoric acid (f-0.7), the incorporation of methionine was almost equal; but was much lower than in phosphorylase and phosphofructokinase. It is shown that the intensity of methionine does not depend on the nature of the sulfur-containing amino acids in the protein. This introduction does not alter the enzymatic

activity of aldolase and phosphofructokinase isolated from rabbit muscles. (B.O.G.)

14642

RADIOISOTOPE STUDIES OF FATTY ACID METABOLISM. James F. Mead and David R. Howton. New York, Pergamon Press, 1960. 148p. \$7.50.

Applications of isotopic tracer elements in studies of fatty acid metabolism are reviewed. The availability of a variety of isotopic tracer elements for following molecules and atoms through complex pathways of various metabolic processes, combined with advanced analytical and separation techniques, have permitted separation of lipids and their component fatty acids on very small samples and the identification of components. New methods of isolating, purifying, and handling enzyme preparations have allowed many complex reactions to be carried out and followed *in vitro*. The most important of the tracer elements for studies of lipid metabolism is carbon-14. Results of tracer studies on fatty acid metabolism discussed include digestion and absorption; transport, deposition, and mobilization of fatty acids; turnover and metabolic influences; beta oxidation of fatty acids; interconversions of fatty acids; biosynthesis; phospholipids; and sterol esters. Complete author and subject indexes are included. (C.H.)

14643

THE METHOD OF ISOTOPIC TRACERS APPLIED TO THE STUDY OF ACTIVE ION TRANSPORT. 1st CONFERENCE ON BIOLOGY AT SACLAY, 3 & 4 JULY, 1958. New York, Pergamon Press, 1959. 202p. (In French and English)

A conference was held at Saclay, France, in July 1958 to discuss recent findings in studies of active ion transport in biological systems. Emphasis was placed on the development of isotopic tracer methods and the interpretation of results furnished by tracer studies. Topics discussed include present evidence in the redox pump theory, transport of muscle ions, sodium-potassium exchange, chemical factors controlling ion movements during nerve activity, the relation between metabolism and the transport of active ions in cells, current-voltage curves of Ranvier nodes, ion and water transport in the kidney, the importance of certain physiological factors in the transport of both electrolytes and nonelectrolytes, active and passive transport across epithelial membranes, interpretation of measurements of the flux of ion transport across membranes in biological systems, and the endocrine control of sodium transport and urinary excretion of electrolytes. (C.H.)

14644

RECHERCHES EXPERIMENTALES SUR LES POSSIBILITÉS D'UTILISATION DU BORE 10 DANS LE TRAITEMENT DES GLIOMES INTRACRANIENS PAR LA CAPTURE DES NEUTRONS LENTS. (Experimental Investigations on the Possibilities of the Utilization of Boron-10 in the Treatment of Intracranial Gliomas by the Capture of Slow Neutrons). Simon Thiry. Thesis, Liège, Université de Liège, 1959. 114p.

The utilization of B¹⁰ in the therapy of intracranial gliomas with slow neutrons was studied in mice having experimental tumors. A large number of mineral and organic compounds of boron were examined to eliminate first those compounds with a toxic effect in mice. The eighteen remaining compounds were injected into mice having experimentally transplanted gliomas. The effect on the tumor/brain differential concentration of the dose administered, the chemical structure of the compound, the time after injection, mode of injection, the nature and location of the tumor, and different clinical conditions were determined. Tri-isopropanolamine sodium was the compound

selected as having the best tumor/brain differential concentration. A rigorous technique for the exposure to the slow neutrons for the treatment of the tumor was developed. The difficulties found in the irradiation are discussed in some detail and methods for avoiding them are considered. (J.S.R.)

Fallout and Ecology

14645

CAESIUM-137 IN TORONTO MILK DURING 1959. K. G. McNeill and O. A. D. Trojan (Univ. of Toronto). *Nature* 186, 399-400(1960) Apr. 30.

Results of measurements are presented on the cesium-137 content of milk taken from the Toronto milk-shed during the period April 1959 to February 1960. Data are presented graphically. Results are compared with data on fall-out and cattle feeding during the period. (C.H.)

14646

RADIOCAESIUM AND POTASSIUM-40 IN NORWEGIAN-PRODUCED MILK. K. Madshus and J. Baarli (Norsk Hydro's Inst. for Cancer Research, Oslo). *Nature* 186, 527-9(1960) May 14.

Samples of milk collected in Norway between January 1958 and August 1959 were analyzed for cesium-137 and potassium-40 content. Results are compared with data on total fall-out and rainfall during the period. The cesium-137 in milk increased considerably during the period. The hazards of genetic effects of gamma radiation from cesium-137 are discussed briefly. (C.H.)

14647

CAESIUM-137 IN SPRAY-DRIED DANISH MILK. Per Gert Jensen (Finsenlaboratory, Copenhagen). *Nature* 186, 562-3(1960) May 14.

The cesium-137 content of spray-dried milk was measured in samples collected in Denmark from 1949 to December 1959. Data are presented graphically and results are discussed. (C.H.)

14648

FALL-OUT RADIOACTIVITY IN SOUTHERN SWEDEN. Pontus Ljunggren (Geological Inst., Lund, Sweden). *Nature* 186, 655-8(1960) May 21.

The radioactivity in ash from various parts of a spruce tree was determined in a study of the high enrichment of radioactive fall-out products in Sweden during 1959. Data indicate a marked enrichment of radioactive substances in both the twigs and needles. It was concluded that fall-out radioactivity is mainly taken up by exposed parts of plants directly from the air and only to a very small extent from the soil through the root-system of the plant. (C.H.)

14649

RADIOACTIVE FALLOUT. WHAT'S BEING DONE ABOUT IT. PART I. HOW PLANT FOODS PROTECT PLANTS. Eric B. Fowler (Los Alamos Scientific Lab., N. Mex.). *Plant Food Rev.* 5, No. 2-4, 27-30(1959).

Findings are reviewed from a number of studies on factors involved in the incorporation of fission products into the food chain. Emphasis is placed on factors affecting the uptake of strontium-90 and cesium-137 by plants. Topics discussed include the relationship of soil and soil factors to the fission products; the physiology and nutrition of agricultural crops and their relationship to the soils from which they remove radionuclides; and the use of chemical additives to the soil to immobilize the unwanted radionuclides and thus make them unavailable or less available to the plant. (C.H.)

14650

ACCUMULATION OF STRONTIUM-90 AND CALCIUM-45 BY FRESH WATER FISHES. Harold L. Rosenthal (Washington Univ., St. Louis). *Proc. Soc. Exptl. Biol. Med.* 104, 88-91(1960) May.

Data are presented which indicate that fresh water fishes display only a small degree of discrimination against strontium relative to calcium. The data are based on results of a study using double tracer techniques. (C.H.)

14651

FALLOUT IN NEW YORK CITY DURING 1958. THE DATA INDICATE THAT SHORT-LIVED FISSION PRODUCTS MAKE A MAJOR CONTRIBUTION TO RADIATION DOSE RATES. George A. Welford and William R. Collins, Jr. (U. S. Atomic Energy Commission, New York). *Science* 131, 1711-15(1960) June 10.

Data are presented on the levels of strontium-90, strontium-89, cesium-137, zirconium-95, cerium-144, yttrium-91, and tungsten-185 in samples of air and rain water and air collected in New York City during 1958. The data indicate that short-lived fission products make a major contribution to fall-out radiation dose rates. (C.H.)

14652

BEHAVIOR OF BICARBONATE AND SR85 IN SOILS. R. B. Clark, G. B. Blank, V. Q. Hale, and A. Wallace (Univ. of California, Los Angeles). *Soil Sci.* 89, 292-5(1960) May.

Bicarbonate stability was measured in a calcareous and in a noncalcareous soil. Bicarbonates were lost from soil solutions to a greater extent from the calcareous soil than from the noncalcareous soil. The drying of soils to which HCO_3^- had been added resulted in the large majority of HCO_3^- being lost. From one-half to nearly all of the Cl^- from NaHClO_4 applied to the soils was lost in equilibrium conditions with drying of the soils. Losses were greater with the noncalcareous than with the calcareous soil and these greatly exceeded the acidity of the noncalcareous soil. The relationship of this to the failure of HCO_3^- to induce iron chlorosis in certain soils was discussed. Strontium-85 was precipitated in soils by NaHCO_3 additions. Strontium-85 was somewhat less soluble in the calcareous than in the noncalcareous soil. Drying of the soil that had received solutions of NaHCO_3 and Strontium-85 resulted in a decrease in Strontium-85 solubility beyond the NaHCO_3 effect. (auth)

Radiation Effects on Living Tissues

14653 AD-212169

Texas. Agricultural and Mechanical Coll., College Station. Engineering Experiment Station. Radiation Biology Lab.

THE INFLUENCE OF DIETARY DEFICIENCIES ON THE SURVIVAL OF ALBINO RATS AND MICE SUBJECT TO CONTINUOUS LOW INTENSITY RADIATION. Progress Report [for] June 1958-February 1959. Sidney O. Brown. Feb. 24, 1959. 70p. Contract DA-007-MD-957.

With this is bound: Appendix: Texas Woman's Univ., Denton. PROGRESS REPORT [FOR] JUNE 1958-MARCH 1959. [PART] II. SKELETAL STATUS OF THE ALBINO RAT AT VARIED PROTEIN LEVELS IN A CONSTANT RADIATION FIELD. Pauline Beery Mack, George P. Vose, and Ralph E. Pyke. Mar. 1, 1959. Contract DA-49-007-MD-956.

A low intensity radiation facility is described which presents levels of radiation of 2, 5, 10, and 20 r per 23-hour day. This facility was used to investigate the influence of protein deficiencies on the rate of bone growth

and maturation in albino rats subjected to continuous low intensity irradiation. Variations of dietary protein between 7 and 25% affected the density of growing bone, the rats on the higher protein levels exhibiting the greatest bone density. The effect of continuous gamma irradiation on bone density is inconclusive. The influence of chronic radiation on fetal development and longevity of Swiss albino mice was investigated. These animals can develop in a constant radiation field of 20 r per day, or below, and remain alive and apparently healthy after a total of 74 days or a cumulative radiation dose of 1480 r since conception. Preliminary data are presented which indicate that no differences in the mortality of pyridoxine and riboflavin deficient animals could be noted when irradiated and non-irradiated animals were compared. Preliminary evidence is presented that indicates that rats maintained on a 7% protein diet and exposed to gamma irradiation at the rate of 20 r per day (total dose: 1568 r) suffer a significantly greater weight loss than do non-irradiated controls maintained on a similar diet. Animals on the same diet, but at different levels of irradiation, do not show significant differences in weight loss nor do other protein diet animals. (auth)

14654 AD-212170

Texas. Agricultural and Mechanical Coll., College Station.

Engineering Experiment Station. Radiation Biology Lab. THE STUDY OF WOUND, BURN, AND FRACTURE HEALING IN THE ALBINO RAT AND MOUSE SUBJECTED TO CONTINUOUS IRRADIATIONS OF DIFFERENT INTENSITIES. Progress Report for June 1958-February 1959. Sidney O. Brown and George M. Krise. Feb. 24, 1959. 64p. Contract DA-007-MD-945.

A chronic, low intensity Co^{60} radiation facility is described which presents useful levels of radiation of 2, 5, 10, and 20 r per 23-hour day. This facility is being used to investigate the influence of chronic radiation on the repair of incised, fractured tibia of albino rats during a twelve week period post fracture. There is some evidence that continuous exposure to 2, 5, and 10 r gamma radiation daily will affect normal deposition of bone mineral adversely in rats of 120 grams weight at the time of initiation of the experiment on animals which were maintained on a normal laboratory diet. Preliminary evidence indicates that incisure healing was affected adversely. Swiss albino mice given radiation levels of 0, 2, 5, and 10 r daily were challenged by 90% burn trauma produced by 70°C water for 5 seconds immersion. Those animals receiving radiation showed a marked decrease in survival for a four day period. Experiments underway on the influence of radiation on the hematology of the albino rat and on the survival of mice given pre- and post-natal low intensity chronic radiation are described. (auth)

14655 NYO-2064

Western Reserve Univ., Cleveland. Atomic Energy Medical Research Project.

EFFECT OF SEGMENTAL GUT SHIELDING ON MORTALITY FROM INTESTINAL RADIATION. J. Chandler Smith. Oct. 15, 1959. 21p. Contract W-31-109-eng-78. OTS.

An experimental method for the isolation of a segment of ileum with vascular supply intact and re-establishment of the continuity of the gut by end-to-end anastomosis in rats is described. Shielding a segment of ileum in continuity with the rest of the small intestine provided protection from radiation of the abdomen with 1000 r; shielding a segment of isolated ileum did not. The beneficial effect of segmental gut shielding in the intestinal radiation syndrome is dependent on the shielded part being in continuity with the

intact ileum. The mechanism of the protective effect of the shielding procedure is probably the reabsorption of fluid and electrolytes through the intact mucosa of the shielded part. No evidence of a protective mechanism independent of the physiologic absorptive function of the shielded part was revealed. Treatment of the intestinal radiation syndrome may depend principally on the restoration of fluid and electrolyte balance during the critical period while the injured mucosa undergoes repair. (auth)

14656 NYO-2907

Western Reserve Univ., Cleveland. Atomic Energy Medical Research Project.

EFFECT OF IRRADIATION ON CELL DIVISION AND NUCLEIC ACID SYNTHESIS IN STRAIN U-12 FIBROBLASTS. Helen Harrington. Dec. 30, 1959. 22p. Contract W-31-109-eng-78. OTS.

The sequence of events following an irradiation of 500 r was investigated in strain U-12 fibroblasts. The irradiation caused a rapid and almost complete inhibition of cell multiplication, as measured by nuclear counts, the mitotic index, and the number of colonies produced from single cells. Although mitotic figures reappeared and increased in frequency to abnormally high levels 13 to 20 hours after irradiation, a recovery in cell multiplication did not occur. Time-lapse cinematography showed that the increased incidence in mitotic figures was very probably caused by the increased time spent by these cells in abortive mitoses. In contrast to the immediate inhibition of mitosis, DNA synthesis was reduced at a later time, falling to less than 50% of the control 18-24 hours after irradiation. In this system, therefore, the immediate inhibition of mitosis cannot be the result of a deficiency in DNA synthesis, as measured by the number of individual cells incorporating H^3 -thymidine or by the specific activity of DNA after incorporation of P^{32} . On the other hand, it is possible that the reduction in the number of cells synthesizing DNA results entirely from the inhibition of mitosis and subsequent failure of the orderly progression of cells through the mitotic cycle. (auth)

14657 TID-5692

Northwestern Univ., Chicago. Medical School. EFFECTS OF RADIATION ON PURE PROTEINS AND NUCLEIC ACIDS. Virgil L. Koenig. [Mar. 1960]. 8p. Project No. 8. Contract AT(11-1)-89. OTS.

Progress is reported in a study on the effects of high-speed electrons and gamma radiation on the properties of pure bovine fibrinogen, human fibrinogen, and thymus desoxyribonucleate. Comparisons were made with data on bovine fibrinogen and desoxyribonucleate exposed to soft x radiation. (C.H.)

14658 TID-5741

Rochester, N. Y. Univ. School of Medicine and Dentistry. THE EFFECTS OF IONIZING RADIATIONS ON PERIPHERAL NERVE. PART I. THE EFFECTS OF IN SITU X-IRRADIATION ON MAMMALIAN NERVE ACTION POTENTIAL. Charles P. Duvall and Edgar L. Gasteiger. PART II. ALTERATION OF RESTING, ACTION AND LOCAL POTENTIALS OF CRAYFISH GIANT AXONS BY UV IRRADIATION. Jasper R. Daube and Edgar L. Gasteiger. Progress Report, 1959-1960. 15p. Contract AT(30-1)-2193. OTS.

Progress is reported in studies on the sensitivity of nerves to exposure to x and ultraviolet radiation. Findings are reported on the response of the sciatic nerve of cats exposed in situ to x radiation and on the response of crayfish giant axons exposed to ultraviolet radiation. Data are presented graphically and results are discussed. (C.H.)

14659 TID-5827

STUDIES ON CHEMICAL PROTECTION AGAINST RADIATION-INDUCED INTESTINAL INJURY. Period covered: June 1, 1959 - March 1, 1960. Emanuel E. Schwartz and Benard Shapiro. Mar. 16, 1960. 7p. Contract AT(30-1)-2406. OTS.

Preliminary results are reported from a study of the protective action of S, 2-aminoethylisothiuronium Br-HBr (AET) and its derivatives against absorption deficiencies and other parameters of radiation injury in the intestine of mice. (C.H.)

14660 TID-5882

Cornell Univ., Ithaca, N. Y. Medical Coll. STUDIES OF PROTEIN SYNTHESIS IN THE GASTROINTESTINAL TRACT OF NORMAL AND IRRADIATED MICE. Final Report. [1960]. 16p. Contract AT(30-1)-2179. OTS.

Progress is reported in studies of protein synthesis in the gastrointestinal tract of normal and irradiated mice. Observations are reported on the effects of radiation on cell division and differentiation, cell migration, and the synthesis of proteins and enzymes within the cells. (C.H.)

14661 USNRDL-TR-405

Naval Radiological Defense Lab., San Francisco. MODERATE LEVEL X-RAY EFFECT ON ACTIVE TRANSPORT MECHANISM IN DOG INTESTINE. B. E. Vaughan and E. L. Alpen. Mar. 8, 1960. 30p.

Earlier reports of this group have described the basic model for analysis of tracer data in the Thiry-Vella preparation using Na^{24} and H^3 as tracers. At that time, it was reported also that the lumen-to-plasma transfer rate of sodium was increased on the 3rd day following 600 r whole-body irradiation (1MVP). It has since also been possible to demonstrate the active transport of water and increases in the magnitude of active water transport on the 2nd to 3rd day. Active water transport is normally about 20 percent of the total unidirectional efflux. After irradiation, active water transport is significantly increased by a factor of 1.7. In accordance with a more recent fluid circuit theory of ion accumulation, the increase in active water transport is observed to be accompanied by the increase in sodium efflux. While diffusional and osmotic factors are still operative, conclusions about active water transport were deduced from independent manipulations of osmotic and diffusional differentials. Observed effects are a consequence of irradiation, as parallel experiments on animals fasted for comparable periods show no change. (auth)

14662 USNRDL-TR-414

Naval Radiological Defense Lab., San Francisco. TOLERANCE OF IRRADIATED ANIMALS TO PROLONGED HYPOXIA. B. D. Newsom and D. J. Kimeldorf. Apr. 6, 1960. 14p.

Rats were maintained at a simulated altitude of 15,000 ft for 30 days following exposure to x-ray doses in the 30-day LD_{10-90} range. Non-irradiated rats maintained concurrently tolerated this level of altitude without apparent distress. The effect of prolonged altitude exposure to the irradiated animals was equivalent to a 100 r decrease in the x-ray dose necessary to produce a 50% mortality response at 30 days. Mice as well as rats exhibited a greater mortality response to a given x-ray dose if maintained at altitude during the post-irradiation period. Red blood cell volume, hemoglobin, and hematocrit values were determined at intervals during thirty days of exposure to 15,000 ft simulated altitude following 450 r or 0 r, and were compared to those for similar groups maintained at sea level. The blood picture of irradiated animals during the first

twenty days at altitude more closely resembled irradiated animals maintained at sea level than the altitude controls. These data suggest that the increased mortality of animals maintained at altitude following radiation exposure is the result of a reduced blood cell volume and an inadequate erythropoietic response during exposure to hypoxia. (auth)

14663 USNRDL-TR-415

Naval Radiological Defense Lab., San Francisco.
RADIOSENSITIVITY OF MOUSE KIDNEY UNDERGOING COMPENSATORY HYPERTROPHY. V. J. Rosen and L. J. Cole. Apr. 8, 1960. 14p.

Groups of 10-week old female LAF₁ mice were subjected to unilateral nephrectomy, and then to a single, high sublethal dose of x radiation (690 r) at 3 hours, or at 48 hours post-nephrectomy. The remaining right kidneys were removed 3 weeks after surgery, weighed and the weights compared with those of the left kidneys removed during nephrectomy. In mice irradiated 48 hours after nephrectomy, the capacity of the kidney to undergo compensatory hypertrophy was essentially the same as that of non-irradiated controls, attaining as much as 50% increase in weight by 3 weeks. By contrast, there was a marked inhibition of compensatory hypertrophy when the irradiation was carried out 3 hours after nephrectomy. When irradiation (690 r) was given one hour before unilateral nephrectomy, there was no apparent impairment of the capacity of the kidney to undergo compensatory hypertrophy. Radiation-inhibition of compensatory hypertrophy was also shown to be correlated with suppression of mitotic activity in the kidneys as detected histologically 48 hours post-nephrectomy. (auth)

14664 USNRDL-TR-417

Naval Radiological Defense Lab., San Francisco.
EFFECTS OF IMMUNIZED RAT BONE MARROW ON LETHALLY IRRADIATED MICE. P. C. Chin and M. S. Silverman. Apr. 29, 1960. 12p.

The time and the incidence of deaths between lethally irradiated mice treated either with non-immune rat bone marrow or treated with marrow from rats pre-immunized against the recipient mice were compared for the purpose of determining the role of the donor cells in the pathogenesis of secondary deaths. On the basis of a graft vs. host reaction, enhancement of the time and incidence of secondary deaths would be expected, due to the heightened immunological reactivity of the pre-immunized marrow against the host. In contrast, a host vs. graft reaction or the unsuccessful colonization of immunologically active donor cells will result in a lack of difference between recipients of either non-immune or pre-immunized marrow. Statistical analysis of the results from the groups of animals in each of three different bone marrow experiments showed no significant difference in either the time or the incidence of deaths. Furthermore, this lack of significant difference was observed even when moderate amounts of either non-immune or pre-immunized rat spleen were administered to recipients of non-immune rat bone marrow. These results suggest that following the injection of rat bone marrow proliferation of immunologically active cells either did not take place or occurred only to a very limited extent. In either instance, a graft vs. host reaction would be unlikely. (auth)

14665 WADC-TR-59-609

Western Biological Labs., Culver City, Calif.
CHRONIC EFFECTS OF LOW-LEVEL RADIATION UPON PROTEIN AND AMINO ACID REQUIREMENTS. Period [covered] August 1, 1958 to May 31, 1959. B. H. Ershoff, A. F. Wells, S. Bernick, H. Sobel, and T. M. Graham. Dec.

1959. 53p. Project title: HEALTH HAZARDS OF MATERIALS RADIATION. Task title: HUMAN FACTORS OF NUCLEAR OPERATIONS. Contract AF33(616)-5873. (AD-233465). OTS.

Immature male rats were fed highly purified diets containing 10, 15, 25, or 45% protein in the form of a cystine-supplemented casein and were continuously exposed for periods as long as 20 weeks to gamma radiation from a cesium-137 source at levels of 0.3, 3, 30, or 300 r per week. Control groups were fed the same diets but were not irradiated. The effects of radiation were neither diminished nor accentuated by alterations in the protein content of the diet. Substituting other proteins or mixtures of amino acids isonitrogenously for cystine-supplemented casein was also without significant effect on radiation response. Oral administration of AET in the diet or by forced feeding just prior to exposure did not afford protection against a single acute dose of x-irradiation in the rat. Incorporating AET in the diet was also ineffective in protecting rats continuously administered gamma radiation for 8 weeks at a level of 300 r per week. Rats continuously exposed to gamma radiation exhibited an impaired discrimination learning performance and depressed general activity at levels well below the minimum dose required for detectable chemical or morphologic effects. (auth)

14666 JPRS-2515

RESTORATION OF VIABILITY OF IRRADIATED YEAST CELLS. V. I. Korogodin and T. S. Malyutina. Translated from *Priroda* 48, No. 10, 82-5(1959). 7p. OTS.

Experiments on post-irradiation regeneration of diploid yeast were conducted to check an earlier finding that part of the population preserves its viability through the waste products of damaged cells. The results were confirmed, but other experiments were conducted to test the explanation. After irradiation a culture was diluted and divided into 30 to 40 parts containing about 50 cells each. The frequency of occurrence of viable cells indicates that post-irradiation regeneration is not restricted to diploid cells, but is a characteristic of many unicellular as well as multicellular organisms. (T.R.H.)

14667 JPRS-L-818-N

GENERAL PRINCIPLES IN THE TREATMENT OF COMBINED RADIATION AFFECTIONS. B. M. Khromov. Translated from *Klin. Med. (U.S.S.R.)* 37, No. 4, 5-11 (1959). 11p. OTS.

The treatment of radiation injuries when complicated by mechanical or thermal trauma is discussed. Such injuries are also often complicated further by the development of infection. The general and local resistance of the body is lowered through the action of ionizing radiation. The presence of toxemia, anemia, leukopenia, reduction of phagocytic activity of leukocytes, decrease in the immunobiological defense mechanisms, weakening of the barrier properties of tissues, increase in tissue permeability, decrease in the antitoxic functions of various organs and tissues, and changes in inflammatory reaction are considered. In giving medical aid to patients, special attention should be given to the prophylaxis of shock and countershock measures, and the fight against infection and a bleeding tendency. It is concluded that the treatment of combined radiation injuries represents a complex problem which may be solved by means of the correct and individual use of the whole complex of therapeutic measures. It is emphasized that the patient should not be overloaded with numerous drugs and procedures. The stage of development and characteristics of the course of radiation injury and the wound process should govern the treatment. (C.H.)

14668 JPRS-L-834-N

CHARACTERISTICS OF THE REACTION OF IRRADIATED ANIMALS TO GENERAL COOLING. Ya. I. Veksler. Translated from *Patolog. Fiziol. i Eksptl'. Terap.* **3**, No. 1, 27-9(1959). 8p. OTS.

Results of studies on rats indicate that in animals damaged by penetrating radiation the compensatory reactions to artificial cooling are reduced and are quickly exhausted in the process of induced hypothermia. (C.H.)

14669 JPRS-L-838-N

RESULTS OF THE SECOND SCIENTIFIC CONFERENCE ON THE PROBLEM OF THE EFFECT OF IONIZING RADIATION ON THE HIGHER BRANCHES OF THE CENTRAL NERVOUS SYSTEM. A. M. Ivanitskii (Ivanitskiy). Translated from *Patol. Fiziol. i Eksptl'. Terap.* **3**, No. 1, 93-4(1959). 4p. OTS.

The Second Scientific Conference on the Problem of the Effect of Ionizing Radiation on the Higher Branches of the Central Nervous System was convened at Moscow in May, 1958. A summary is presented of information contained in papers presented at this conference. Papers covered the influence of radiation on the nervous system of the offspring, the effects of small chronic doses of radiation on nervous activity, and the mechanisms underlying the effects of radiation on the higher divisions of the central nervous system. (C.H.)

14670 JPRS-L-894-N

THE EFFECT OF PENETRATING RADIATION ON DEVELOPMENT OF THE FETUS UNDER EXPERIMENTAL CONDITIONS. S. L. Petrosyan and Z. F. Lopatnikova. Translated from *Vestnik Rentgenol. i Radiol.* **34**, 38-42 (1959). 8p. OTS.

Irradiation of rats in the first half of pregnancy with a dose of 500 r leads to death of the embryos in the early stages of growth, which explains the large percentage of non-deliveries in pregnancy. Rats born of this group were underweight; they showed changes in the fur and anomalous development of vertebrae. Irradiation in the second half of pregnancy under the same conditions elicits in the post-natal period the onset of acute radiation sickness, with a mortality rate of 92 percent. (auth)

14671 JPRS-L-901-N

EARLY CHANGES OF DOGS' SKELETONS FOLLOWING RADIOACTIVE STRONTIUM AND YTTRIUM IRRADIATION. N. N. Litvinov. Translated from *Arkh. Patol.* **21**, No. 5, 12-18(1959). 9p. OTS.

In the subacute and chronic intoxication of dogs with radioactive strontium and yttrium considerable skeletal changes were observed which were more pronounced in the spongy layer of the bones. The greatest changes were observed in the vertebrae, sternum, ribs, and metaphyses of the long tubular bones. In young dogs, the most significant changes of the skeleton occurred in the growth zones of long tubular bones. The initial skeletal changes consist of an increase of the reorganization of bone tissue with the predominance of resorption of it and proliferation of endosteal tissue containing a large number of osteoclasts. Cavitory resorption is a predominant mechanism of bone resorption. Afterwards a depression of the bone activity and a reduction in the quantity of osteogenic tissue is observed, particularly frequently in dogs which die. The processes of bone reorganization, including resorption, are considerably decreased. In dogs killed in subsequent periods a certain activation of reorganization of bone structures is observed with the predominance of bone resorption. Along with this, changes begin to be manifested which attest to the progressive disturbance of the processes of

osteogenesis and the formation of immature and of primitive bone structures of the osteoid type, coarsely-fibrillar bone and calcified collagen. The changes of the skeleton of dogs indicated resembled to a great extent the early changes in the skeleton of white rats after chronic and subacute intoxication by radioactive strontium. (auth)

14672 JPRS-L-923-N

THE INFLUENCE OF THE DOSE RATE OF RADIATION ON THE BIOLOGICAL EFFECT. L. V. Kozlova. Translated from *Med. Radiol.* **4**, No. 5, 43-52(1959). 8p. OTS.

With a total-body irradiation of rats with x rays using dose rates of 130 r per second and 1.3 r per second in a dose range from 390 to 780 r a tendency is manifested toward a reduction in the biological effect of high dose-rate radiation. Data were obtained which permit us to suppose that in the high dose range, 910 r and over, the effect of the dose rate of radiation is subordinate to a different function. Further study of the problem lies along the line of statistical reliability of the observations and interpretation of them by means of concepts concerning the primary processes of the reaction of radiation with tissues. (auth)

14673 JPRS-L-1820-D

CHANGES IN THE HIGHER NERVOUS ACTIVITY OF DOGS UNDER LONG-TERM EXPOSURE TO SMALL DOSES OF IONIZING RADIATION. O. F. Makarchenko and R. S. Zlatin. Translated from *Fiziol. Zhur. Akad. Nauk Ukr. R.S.R.* **5**, 16-21(1959). 7p. OTS.

Long-term exposure of dogs to small doses of gamma radiation caused functional changes in conditioned reflex activity. Changes in the composition of the peripheral blood were manifest later than disturbances in higher nervous activity. (C.H.)

14674

THE EFFECT OF CARDIAC IRRADIATION UPON THE ELECTROCARDIOGRAM OF THE NORMAL CANINE HEART. Elliot Senderoff, Melvin Kahn, Harvey Peck, and Ivan D. Baronofsky (Mount Sinai Hospital, New York). *Am. J. Roentgenol., Radium Therapy Nuclear Med.* **83**, 1078-82 (1960) June.

Electrocardiograms were obtained on 52 normal dogs before and after cardiac irradiation with 1,300, 2,000, and 2,500 r. No ectopic cardiac arrhythmias were noted on electrocardiograms obtained 7 to 90 days following the completion of the course of irradiation. A mean increase in the ventricular rate was noted 7 days following the completion of the course of irradiation, but was not present 30 to 60 days later. There was no prolongation of PR interval or QRS duration following cardiac irradiation. At the dosage levels employed, irradiation of the normal canine heart produced no electrocardiographic changes indicative of gross myocardial damage. This was noted to be true as long as 90 days following the completion of the course of irradiation. (auth)

14675

FACTORS INFLUENCING RESPONSE AND RECOVERY OF GRAFTED SKIN TO IONIZING IRRADIATION. EXPERIMENTAL OBSERVATIONS. Jerry W. Grise, Philip Rubin, Anatol Ryplansky, and Lester Cramer (Strong Memorial Hospital, Rochester, N. Y.). *Am. J. Roentgenol., Radium Therapy Nuclear Med.* **83**, 1087-96(1960) June.

An experimental program was evolved to study the following variables when irradiating skin grafts: The quality of the radiation, fractionation and protraction of dose, the age of the graft, and the thickness of the graft. From the results of these studies and the clinical observations noted, an analysis of tolerance based on response and recovery

patterns is presented. The therapeutic implications of these studies are listed as a guide to the radiotherapist in the hope of increasing the tolerance of irradiated grafts.

(auth)

14676

THE VASCULAR PATHOPHYSIOLOGY OF AN IRRADIATED GRAFT. Philip Rubin, George Casarett, and Jerry W. Grise (Strong Memorial Hospital, Rochester, N. Y.). *Am. J. Roentgenol., Radium Therapy Nuclear Med.* 83, 1097-1104(1960) June.

The difference in the vascularization of grafted and normal skin forms a reasonable basis for explaining the differences in the radiation reactions of these structures. The radioisotope half time of disappearance following subcutaneous injection is an index of vascular integrity of the graft and serves as a parameter to predict its radioresponsiveness. In developing a concept of the spectrum of reactions of grafted skin to ionizing irradiation, knowledge of the radiopathologic changes in capillaries must be utilized with knowledge of the histophysiology of the vascularity of an autograft. (auth)

14677

THE EFFECT OF X RAYS ON THE LARVA OF THE ANFIBI ANURI. GRAFTS OF JOINTS AND ADMINISTRATION OF THYROXINE. Teodoro Perri (Università, Perugia, Italy). *Atti accad. naz. Lincei. Rend. Classe sci. fis. mat. e nat.* (8) 27, 259-63(1959) Nov. (In Italian)

The effect of x rays on the larvae of Anfibii anuri and particularly on their endocrine balance was studied. The effect studied was the variation of the growth velocity of the joints of normal larvae transplanted onto x-irradiated larvae, either homoplastically (Bufo vulgaris and Bufo viridis) or heteroplastically (Bufo viridis and Bufo vulgaris). A joint transplant from normal larvae of Bufo vulgaris or Bufo viridis on x-irradiated larvae of Bufo vulgaris has a growth rate much less than that found in transplants on normal larvae of Bufo vulgaris. It is suggested that this results from the radiation-induced decrease of the endocrine activity of the carrier, particularly of the thyroxine activity. It is seen that in transplants from Bufo viridis on irradiated Bufo vulgaris, if the carrier larvae are treated with thyroxine, the transplants have a sharply increased growth. (J.S.R.)

14678

THE RELATIVE BIOLOGICAL EFFICIENCY OF 20 MV AND 4 MV RADIATIONS. PAPERS READ AT THE ANNUAL CONGRESS OF THE BRITISH INSTITUTE OF RADIOLOGY ON DECEMBER 11, 1959. Ralston Paterson, David Greene, John B. Massey, W. M. Dale, J. V. Davies, J. P. Keene, C. Russell, A. J. Bateman, Edith Paterson, and D. D. Porteous (Christie Hospital, Manchester, Eng.). *Brit. J. Radiol.* 33, 271-86(1960) May.

Problems involved in measuring the relative biological efficiency of 20 Mv and 4 Mv radiations are reviewed. Physical problems are discussed and results are presented from studies on the radioinduced oxidation of ferrous sulfate solution, the survival of irradiated Escherichia coli, the induction of dominant lethal mutations in irradiated Drosophila sperm, and organ weight and mortality in irradiated mice. It is concluded that for clinical purposes there is no need as yet to take more than one RBE value for the whole megavoltage range from cobalt to at least 20 million compared to conventional deep therapy. This value lies between 80 and 90, and it is proposed to use 100 to 85 as a single factor to cover cobalt, 4 Mv, and betatron radiations. (C.H.)

14679

EFFECTS OF PROTRACTED IRRADIATION ON THE BLOOD FORMING ORGANS OF THE RAT. PART I: CONTINUOUS EXPOSURE. L. F. Lamerton, A. H. Pontifex, N. M. Blackett, and Kay Adams (Inst. of Cancer Research, Royal Cancer Hospital, London). *Brit. J. Radiol.* 33, 287-301(1960) May.

A study has been made of the changes in the blood and bone marrow of rats subjected to continuous irradiation from a Cs¹³⁷ source at dose rates from 16 to 415 rads/day. At dose rates of 84 rads/day and below there is a recovery in platelets and white cells after an initial fall. This recovery commences at about 20 days after the start of irradiation and at 84 rads/day is only transient. At 50 rads/day and below, however, near normal levels of blood count are maintained for a long period of time. Splenectomy profoundly affects the pattern of change, particularly with respect to the platelet level and the level of mononuclear leukocytes. Possible mechanisms for the maintenance of a steady state under continuous irradiation are discussed in relation to similar findings in the response of the intestinal epithelium. (auth)

14680

THE PROTECTIVE EFFECT OF CYSTEAMIN UPON THE POST-IRRADIATION STERILITY OF YOUNG RATS EXPOSED TO SUBLETHAL DOSES OF X-IRRADIATION AND SOMATIC CHANGES IN THE FIRST GENERATION. N. V. Savković, D. V. Radivojević, and S. I. Hajduković. *Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade)* 10, 107-11 (1960) Mar. (In English)

The influence of sublethal doses (600 r) of x rays on the reproductive ability of infantile rats treated with cysteamine was studied. The results show that cysteamine has no protective effect on females but that the effect is significant on males and is accompanied by a considerable fertility. The progeny of the first generation both of irradiated males and normal females shows a high mortality rate just after their birth, and considerable stagnation in growth and body weight. (auth)

14681

THE PROTECTIVE EFFECT OF AET UPON SURVIVAL OF YOUNG RATS EXPOSED TO SUBLETHAL AND LETHAL DOSES OF X-RAYS. N. V. Savković, D. V. Radivojević, M. M. Jovanović, and S. I. Hajduković. *Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade)* 10, 113-17 (1960) Mar. (In English)

The optimal dose of AET in x-irradiated rats for survival was investigated by measuring the survival rate as a function of x ray doses and the degree of protection of young rats irradiated before and after the appearance of the stress reaction. The results show that the optimal dose of AET for young rats is 150 mg/kg of body weight. The best protection is obtained with this dose when the animals are irradiated with 600 r. The protective effect of AET is more clearly expressed in animals with a developed mechanism of stress reaction. (auth)

14682

EFFECTS OF SUSPENSIONS OF HOMOLOGOUS BLOOD PLATELETS ON SURVIVAL OF IRRADIATED RATS. Vukica M. Ninković and Ljubica G. Grban. *Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade)* 10, 119-25(1960) Mar. (In French)

The effects of transfusions of homologous blood platelet suspensions alone and in combination with chemical protecting agents (Becapant and AET) on the survival of rats irradiated with 800 r were investigated. Transfu-

sions alone have no noteworthy effect, but in combination with chemical protectors give a protective effect of 80%. (auth)

14683

THE INDUCTION OF HEMATOPOIETIN IN RABBITS IRRADIATED WITH SUBLETHAL, LETHAL AND SUPRALETHAL DOSES OF X RAYS. M. B. Dragić, M. G. Adamović, S. J. Hajduković, and M. M. Radotić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade) 10, 127-36(1960) Mar. (In French)

The influence of sublethal, lethal, and supralethal doses of x rays upon the induction of hematopoietin in rabbits was investigated, as well as the influence of the same doses upon the hematopoietin previously induced by bleeding of the same animals. The results show that the hematopoietin can be induced in rabbits irradiated up to 3,000 r. Previously induced hematopoietin by bleeding is very sensitive toward radiation, its activity being depressed after 700 r. (auth)

14684

EARLY CHANGES IN THE ACTIVITY OF DNA-ase ACID IN URINE OF IRRADIATED MEN. Milan M. Jovanović. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade) 10, 137-9(1960) Mar. (In French)

The activity of DNA-ase acid in the urine of irradiated men was studied. Increased enzymatic activity was found which is not always proportional to the received dose of irradiation. (auth)

14685

ANTIBODY FORMATION IN X-IRRADIATED RATS PROTECTED WITH β -MERCAPTOETHYLAMINE AND β -AMINOETHYLISOTHIOURONIUM. Miroslav M. Simić, Vojin S. Šljivić, and Milica Ž. Petković. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade) 10, 149-61(1960) Mar. (In English)

The investigation of antibody formation was carried out using the sensitive and quantitative technique of titrating hemolysin in 50% hemolytic units and methods of obtaining antibody curves for each rat. Rats irradiated with 550 r total-body x irradiation and immunized 24 hours later with a 0.25% suspension of sheep red cells showed a marked suppression of hemolysin formation. Comparison of log peak titer, induction period and antibody rise to peak and rate of formation gave highly significant differences as compared with nonirradiated control group. Cysteamine given before the exposure to x irradiation protected significantly the induction period, but allowed only about 7% of the expected antibody to be formed at a slightly protected rate of formation within a prolonged antibody rise to peak. AET given before the x irradiation protected only the induction period. Other measures of the antibody response were practically the same as in irradiated controls. Cysteamine or AET given 24 hours before the immunization had no effect on hemolysin formation in nonirradiated rats. (auth)

14686

HEMOLYSIN FORMATION IN INTACT, SPLENECTOMIZED AND X-IRRADIATED RATS. Vojin S. Šljivić, Miroslav M. Simić, and Milica Ž. Petković. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade) 10, 163-72(1960) Mar. (In English)

Hemolysin formation was studied in intact, splenectomized, x-irradiated as well as in splenectomized and x-irradiated rats immunized with sheep red cells. Following a single intravenous injection of antigen, hemolysins reached in intact rats high titers at a rapid rate of accumulation after a short induction and rise to peak period. Splenectomy performed 3 days or 4 to 6 weeks before the

immunization markedly suppressed and delayed the antibody response (splenectomized rats formed only 1.4% of the amount of antibody formed by intact). Total-body x irradiation with 480 r produced a significant suppression of the amount of antibody, a lengthening of the induction and rise to peak time, and a slowing of the rate of antibody formation. Splenectomy followed by x irradiation almost completely inhibited the hemolysin formation. These results show that the spleen in the rats is the most important site of hemolysin formation after a single intravenous injection of a small amount of antigen. In x-irradiated rats the spleen remains the most important site of hemolysin formation. (auth)

14657

GASTRIC CHEMICAL PROCESS AND PRODUCTION OF GASTRIC ULCERS BY IRRADIATION IN THE RABBIT. J. Haot (Université, Liège). Compt. rend. soc. biol. 153, 1874-6(1959). (In French)

The localized irradiation of the stomach of the rabbit causes a very large decrease of the hydrochloro-peptic secretion. The hyposecretion of pepsine is more durable than that of the hydrochloric acid. At the time when the ulcers appear (about the 14th day after irradiation), the secretory activity has reached a minimum. This supports the thesis that the development of ulcerous lesions in these animals is not connected to secretion variations but is bound with circulatory disturbances. (tr-auth)

14688

SUPRARENAL REACTIONS AFTER WHOLE-BODY IRRADIATION IN THE HAMSTER. E. H. Betz (Université, Liège). Compt. rend. soc. biol. 153, 1876-8(1959). (In French)

The adrenal gland of the hamster exposed to whole-body irradiation shows peculiar structural modifications: appearance of lipid drops in the internal part of the fasciculi and the reticuli and vacuola degeneration of the cells at the same place. This vacuolization has been previously reported. It is difficult to decide the actual significance of these modifications because the structure of the adrenal of the hamster is poorly known. ACTH causes a clear appearance of lipids in the fasciculi and reticuli. The vacuolization of the cells is also increased by irradiation and ACTH. It is evident that the irradiation causes corticoadrenal stimulation. (tr-auth)

14689

RESULTS OF THE LOCALIZED RADIATION OF THE FETAL LIVER OF THE MOUSE. II. WEIGHT MODIFICATIONS. J.-F. Duplan and H. Izadian (Institut du Radium, Paris). Compt. rend. soc. biol. 153, 1951-4(1959) Dec. (In French)

The effect of a localized irradiation on the weight of the fetal liver of a mouse exposed to 200, 500, and 800 r from the 14th to the 18th day of gestation was studied. The mothers were sacrificed 1, 2, 3, or 4 days after the irradiation, but always before giving birth. After sacrifice the fetus was weighed and then the liver was removed and also weighed. The results are tabulated and show that the fetal weight is less when the dose is high, when the delay between the irradiation and the sacrifice is greater, and when the irradiation is early. The drop in the weight of the liver is greater when the irradiation dose is high, when the delay between the irradiation and sacrifice is shorter, and when the irradiation is early. The loss in liver weight shows the high radiosensitivity of the fetal hepatic tissue. (J.S.R.)

14690

EFFECT OF AMINOETHYL THIOUREA ON THE SUC-

CINODEHYDROGENASE ACTIVITY OF THE LIVER OF THE MOUSE SUBMITTED TO γ RADIATIONS OF Co^{60} . J. Cheymol, R. Goossens, M. Adolphe, and A. Roux (Faculté de Médecine, Paris). *Compt. rend. soc. biol.* **153**, 1965-8(1959) Dec. (In French)

The activity of the succinodehydrogenase of the liver of the mouse exposed to γ radiation was studied, and the effects of aminoethyl thiourea on the activity were investigated. The results are tabulated and show that the γ radiations (900 r) not only do not inhibit the succinodehydrogenase activity but seem to increase it. AET causes in this enzyme system the same effect as the γ radiation and brings no compensation to the disturbances caused by the irradiation. (tr-auth)

14691

ON THE NATURE OF CHANGES IN THE POLYMER SPECTRUM OF DNA EXPOSED TO γ -IRRADIATION IN SOLUTIONS. A. M. Kuzin, K. A. Struchkov, and N. B. Strazhevskaya (Inst. of Biological Physics, Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* **130**, 895-7(1960) Feb. 1. (In Russian)

Observations on DNA (desoxyribonucleic acid) following exposure to Co^{60} γ rays indicate strong radiosensitivity of the high polymer component. Exposure to large doses of γ radiation does not induce depolymerization but breaks it into pieces of high polymer. The data and method of investigation are suggested for future studies of DNA alterations in organs of irradiated animals. (R.V.J.)

14692

ON THE EFFECT OF X-RAY TREATMENT OF PREGNANT FEMALES ON THE FUNCTIONAL STATE OF THE HIGHER SECTIONS OF CENTRAL NERVOUS SYSTEM OF THEIR PROGENY IN POSTNATAL ONTOGENESIS. I. A. Plontkovskiy and R. I. Kruglikov (Inst. of Higher Nervous System, Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* **130**, 898-900(1960) Feb. 1. (In Russian)

Regularities in nervous system postnatal ontogenesis were studied in rabbits (23-day pregnant) exposed to single whole-body irradiations of 400 r at 16.5 r/min. (R.V.J.)

14693

THE EFFECT OF TEMPERATURE ON THE RESPONSE OF PARAMOECIA TO IRRADIATION. I. B. Smirnova (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* **130**, 901-3(1960) Feb. 1. (In Russian)

Studies with *Paramecium caudatum* irradiated by 4250 r/min at 0, 12, 14, 20, 29, 33, 36, and 38°C show a direct relationship between the initial injuries and the temperature during exposure. Irradiation of infusoria at temperatures below the optimum followed by an exposure at higher than optimum temperature produces a more favorable effect in the reaction of cells to radiation. (R.V.J.)

14694

ANTIBIOTICS AS SUBSTANCES REDUCING THE EFFECT OF IRRADIATION ON CELLS. N. I. Shapiro and N. V. Belitzina (Inst. of Biological Physics, Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* **130**, 904-7(1960) Feb. 1. (In Russian)

Studies were made of the effects of antibiotics on the biological effectiveness of radiation not related to reducing infections. The direct effects of streptomycin on the radiosensitivity of carcinoma cells in mice were studied using the frequency of chromosome aberration as the criterion. Tabulated data show that, depending on the concentration, streptomycin modifies the effects of radiation. Small amounts of antibiotics do not produce an ap-

preciable effect. Studies were also made of the effects of streptomycin on white corpuscles in mice following whole-body exposure to 3000 r (Co^{60}) at 290 r/min. (R.V.J.)

14695

RESISTANCE INCREASE TO IONIZING RADIATION IN ANIMALS PREVIOUSLY SUBJECTED TO X RAY TREATMENT. N. I. Nuzhdin, M. D. Pomerantseva, and N. N. Kuznetsova (Inst. of Genetics, Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* **130**, 1359-61(1960) Feb. 21. (In Russian)

The protective effects of preliminary x radiation were studied using 2.5 month old white mice. Experiments with doses of 15, 25, 50, 100, 150, 200, 250, and 400 r and various intervals between exposures show that preliminary exposure to 15 to 25 r does not alter the radiosensitivity or the survival of animals irradiated with 600 r 14 days following the preliminary exposure. Preliminary exposure to 50, 100, and 200 r considerably increases the survival rate under the same conditions. (R.V.J.)

14696

A STUDY OF COLLAGEN IN HUMID CONDITION IN A GAS MICROCHAMBER OF AN ELECTRON MICROSCOPE. THE EFFECT OF IONIZING RADIATION ON COLLAGEN. I. G. Stovenova, T. A. Nekrasova, and A. L. Zaides. *Doklady Akad. Nauk S.S.S.R.* **130**, 1366-9(1960) Feb. 21. (In Russian)

Studies were made of moist, air dried, and vacuum dried collagen after irradiation. Identical collagen fibrils were used. Observations show that the moist specimens possess a more periodic structure than the dry specimens. Radiation induces breakage of some collagen fibril bonds, permitting a determination of the character of procollagen distributions in collagen complexes. (R.V.J.)

14697

RADIATION RESISTANT DERIVATIVES OF L STRAIN MOUSE CELLS. J. F. Whitfield and R. H. Rixon (Atomic Energy of Canada, Ltd., Chalk River, Ont.). *Exptl. Cell Research* **19**, 531-8(1960) Apr.

A radiation resistant colony has been isolated from the survivors of strain L mouse cells after irradiation with a single dose of 1000 r. Further selection by additional exposures to 1000 r did not result in significant changes in radioresistance. Cells from suspension cultures of this strain and its derivatives retained their colony forming ability to a greater extent than cells of strain L after irradiation with doses ranging from 50 to 1000 r; the survival of the resistant lines was 4 to 5 times that of strain L after irradiation with 1000 r. Initial growth in suspension cultures of R3 was much less affected by irradiation with 1000 r than it was in cultures of strain L. In addition, decline in cell numbers in cultures of R3 irradiated with 2000 and 3000 r was less marked than in cultures of strain L. (auth)

14698

PHOSPHOLIPID METABOLISM IN IRRADIATED RATS. M. Skalka (Czechoslovak Academy of Sciences, Brno). *Folia Biol. (Prague)* **6**, 152-3(1960). (In English)

Results are presented from a study of the effects of whole-body x irradiation on the synthesis of liver and plasma phospholipids in rats. Phosphorus-32 was used as a tracer. Results indicate a severe disturbance of liver functions during the second week after irradiation. (C.H.)

14699

THE EFFECT OF WHOLE BODY X IRRADIATION ON THE LIPOPROTEIDS AND PROTEINS. (ELECTROPHORETIC

INVESTIGATION ON RATS). G. Hinz and M. Kessel (Städtische Krankenhaus Moabit, Berlin and Städtische Krankenhaus Westend, Berlin). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed. **92**, 441-6(1960) Apr. (In German)

The effect of total-body radiation with 300, 500, 600, and 800 r on proteins, lipoproteids, and liver proteins of rats was studied electrophoretically. Single irradiation with 600 r produced a reduction in the albumens with a corresponding rise in alpha and beta globulins; the alpha and beta lipoproteids did not show any quantitative change. The electrophoretically separable and demonstrable liver proteins showed a change in individual animals only but no general alteration was observed following total-body radiation. (auth)

14700

A STUDY OF IMMUNOGENIC AND ANTIGENIC PROPERTIES OF DIPHTHERIA TOXOID EXPOSED TO STERILIZING DOSES OF γ -RAYS. D. R. Kaulen (Gamalei Inst. of Epidemiology and Microbiology, Academy of Medical Sciences, U.S.S.R.). J. Microbiol., Epidemiol. Immunobiol. (U.S.S.R.) (English Translation) **30**, No. 5, 107(1959).

Experimental results indicate that crude diphtheria toxoid may be exposed to sterilizing doses of gamma radiation without damage of its properties. Exposure of purified and adsorbed preparations resulted in a deterioration of immunogenic and antigenic properties of diphtheria toxoid. (C.H.)

14701

MECHANISM OF THE RADIATION EFFECT ON THE SYNTHESIS OF DEOXYRIBONUCLEIC ACID. R. J. Berry, E. Hell, and L. G. Lajtha (Churchill Hospital, Oxford) and M. Ebert (Hammersmith Hospital, London). Nature **186**, 563-4(1960) May 14.

Results are reported from a study on the mechanism of the radiation effect upon the synthesis of desoxyribonucleic acid in mouse Ehrlich ascites tumor cells. The effect of oxygen on the inhibition of synthesis of desoxyribonucleic acid by x radiation was also studied. Data are presented graphically and results are discussed. (C.H.)

14702

CHANGES IN THE DEOXYRIBONUCLEIC ACID CONTENT OF MOUSE SARCOMA 37 CELLS FOLLOWING SERIAL IRRADIATION. A. E. G. Pearson and N. B. Atkin (Mount Vernon Hospital, Northwood, Middlesex, Eng.). Nature **186**, 647-8(1960) May 21.

Measurements were made of the content of desoxyribonucleic acid in mouse sarcoma-37 cells after serial irradiation. (C.H.)

14703

THE EFFECT OF IRRADIATION ON THE REPLICATION OF DESOXY-RIBONUCLEIC ACID IN HEPATOCYTES. W. B. Looney, R. C. Campbell, and Barbara E. Holmes (Univ. of Cambridge, Eng.). Proc. Natl. Acad. Sci. U.S. **46**, 698-708(1960) May.

Autoradiographic studies with tritiated thymidine have shown that no significant difference exists between the number of labeled hepatocytes in the paired controls and the irradiated rats after partial hepatectomy and immediately following 3,000 r of x radiation. Quantitative autoradiographic studies with tritiated thymidine have given results which suggest that the reduction in DNA synthesis immediately following irradiation is directly proportional to the rate of synthesis at the time of irradiation. The mean time for replication of the DNA

content of an hepatocyte of 8 hr in the paired controls was increased to 13 hr in the irradiated animals. The shape of the exponential curve for the changing DNA content during the period of replication following irradiation was similar to the shape of the curve in the controls. The results of this investigation are, therefore, consistent with the assumption that irradiation directly affects the biosynthetic process of DNA replication. (auth)

14704

EFFECT OF ARTIFICIAL HIBERNATION ON THE REACTION OF THE SKIN TO X RAYS. R. Miceli, A. Pavone, and G. E. Zarabini (Università, Bologna). Radioterap. radiobiol. e fis. med. (3) **14**, 409-22(1959). (In Italian)

The effect of artificial hibernation on the reaction of the skin to x radiation was studied in guinea pigs and in man. The first experimental data from this investigation are presented. The results show a clear radioprotective effect of artificial hibernation. (J.S.R.)

14705

INVESTIGATION ON THE EVENTUAL RADIOPROTECTIVE EFFECT OF ROYAL JELLY IN THE RAT. A. Giordano, A. Trenta, and L. Mazza (Università, Pavia, Italy). Radioterap. radiobiol. e fis. med. (3) **14**, 423-39(1959). (In Italian)

Experiments made with equal irradiation (600 r) of groups of rats (*Mus musculus* L.), half of them fed with the usual diet and the other half also given royal jelly, have shown a significant variation between the two groups. The groups fed with royal jelly had a prolongation of the average life, less damage to the hematopoietic system, and, in particular, only reversible alterations to the liver and spleen. From these experimental data and from theoretical considerations on the composition of royal jelly, it is suggested that royal jelly provides a radioprotective effect. (tr-auth)

14706

HISTOLOGICAL AND CYTOCHEMICAL INVESTIGATION ON THE LATEROCERVICAL LYMPHONODES OF THE GUINEA PIG AFTER X IRRADIATION. V. A. Boriani and A. Trenta (Università, Pavia, Italy). Radioterap. radiobiol. e fis. med. (3) **14**, 440-9(1959). (In Italian)

The laterocervical region of a group of young guinea pigs was exposed to x irradiation. The cytological and cytochemical modifications produced by the radiation in the cells of the lymphonodes were studied. There was found, in addition to histological alterations, evidence of a distinct decrease in the nuclear quantity of desoxyribonucleic acid, already well documented histophotometrically in other types of cells examined. These results are briefly discussed. (tr-auth)

14707

EFFECTS OF WHOLE-BODY IRRADIATION ON THE CONSTITUENTS OF THE BLOOD AND ON THE COAGULATION PROCESSES IN THE RABBIT. [PART] III. A. Giordano, A. Trenta, and L. Mazza (Università, Pavia, Italy). Radioterap. radiobiol. e fis. med. (3) **14**, 450-5(1959). (In Italian)

Rabbits exposed to 400 r were examined hematologically. In the first and second weeks after exposure a significant decrease of the red cells, the white cells, the platelets, the electrical resistance of the blood, and also a slowing of the velocity of clot retraction were observed. The data show a correlation of the number of red cells, the electrical resistance of the blood, and the number of platelets with the velocity of clot retraction. (tr-auth)

14708

EFFECTS OF WHOLE-BODY X IRRADIATION ON THE

PRINCIPLE CHEMICAL CONSTITUENTS OF GUINEA-PIG LIVER. O. Lartique (Laboratoire Pasteur de l'Institut du Radium and Institut de Biologie Physico-Chimique, Paris). *Rev. franc. études clin. et biol.* 5, 139-45(1960). (In French)

In the guinea pig, the LD_{50/30} varies according to the type of vegetables fed in the diet. Following whole body irradiation to a LD_{50/30}, deposition of excess neutral fat occurs in the central zone of the liver lobule at the time of the acute phase of the radiation syndrome. A drop in liver glycogen and an increase in liver water are observed concomitantly. These changes are abscopal and transitory effects of x radiation on the liver. X-ray anemia alone is unable to produce a fatty liver in the guinea pig. (auth)

14709

THE EFFECTS OF X RAYS AND CYTOSTATICS ON THE MUTATION RATE IN DROSOPHILA. Gerhard Bettendorf, Heinrich Maass, Eva Kirsten, and Hans A. Künkel (Universitäts-Frauenklinik Hamburg-Eppendorf, Ger.). *Strahlentherapie* 112, 74-8(1960) May. (In German)

By means of the combined application of ionizing rays and the chemical mutagenic substance 2,5-bisethylenimino-benzoquinon-1,4 (BBC) the degree of genetic effect on *Drosophila* was studied. The application of the mutagenic agents in the sequence of BBC + X-ray irradiation caused the addition of the different mutagenic effects, whereas the same treatment in the order of X-ray irradiation + BBC resulted in a considerably reduced yield of mutations. (auth)

14710

ADENINE NUCLEOTIDE CONTENT OF RATS AFTER WHOLE-BODY IRRADIATION. Heinrich Maass (Universitäts-Frauenklinik Hamburg-Eppendorf, Ger.). *Strahlentherapie* 112, 79-85(1960) May. (In German)

The contents of various organs of the rat of adenosine-triphosphate (ATP), adenosinediphosphate (ADP) and adenosinemonophosphate (AMP) show changes following whole body irradiation of 800 r, characterized by a decrease of ATP, an increase of AMP and constant ADP. The changes are not considerably more marked in the liver following irradiation of 3000 r, but significantly more marked in kidney and spleen. In the liver of loirs (glis glis) similar changes of the adenine nucleotides can be observed if the animals are irradiated awake. Hibernating animals showed no radiation damage, however. The characteristic changes of the adenine nucleotides appeared after the animals were roused. (auth)

14711

THE LABILE PHASE OF RADIATION EFFECTS. Wolfgang Dittich (Universitäts-Frauenklinik Hamburg-Eppendorf, Ger.). *Strahlentherapie* 112, 86-91(1960) May. (In German)

Usually the physical-chemical primary happening leads to visible radiobiological effects by a more or less long chain of reactions. During an "unstable phase" of the radiation effect, whose duration depends very much on the conditions of the experiment, suitable external interventions influence—increasing or decreasing—the end effect. This is illustrated by two examples. The irradiated Ehrlich ascites carcinoma of the mouse was treated with oxygen following the irradiation which increased the induction of chromosome aberrations in mitosis cells in one case, and decreased it in the other case considerably. In the second example, in which the anaerobic glycolysis of tumor ascites cells of the Ehrlich carcinoma of the mouse was inhibited by x-rays, oxygen has at least 2 different points of action in its effect on the radiation reaction. The existence of an "unstable

phase" of the radiation effect can also be accommodated in the hit theory by the assumption that the effect likelihood of a hit becomes fixed finally only during the reactions following the physical primary happening under the influence of the secondary conditions. (auth)

14712

BONE MARROW AND ORGAN CHANGES IN IRRADIATED DORMICE. Ulrich Heckmann and Hans A. Künkel (Universitäts-Frauenklinik Hamburg-Eppendorf, Ger.). *Strahlentherapie* 112, 92-104(1960) May. (In German)

Hibernating loirs (glis glis) survive a whole body irradiation with lethal doses for several weeks without external visible damage, if they stay in hibernation. At the end of the hibernation the radiation damage becomes visible and the animals die as if they were irradiated at the time of their waking-up. A cysteine administration at the time of the waking-up (3 weeks following the irradiation) has a significant protective effect. Numerous histological studies on bone marrow, spleen, liver, kidney, adrenals and testes showed that the damage of the cells becomes visible already during the hibernation, but less marked and more protracted than in awake animals. An effect on these radiation induced changes by administration of cysteine following the irradiation could be observed on the plasma and reticulum cells and on the histological structures of the liver. (auth)

14713

THE EFFECTS OF GYNECOLOGICAL RADIUM- AND X-IRRADIATION ON THROMBOCYTES. Brunolf Nold (Universitäts-Frauenklinik Freiburg, B.). *Strahlentherapie* 112, 105-13(1960) May.

The effect of gynecologic radium- and x-ray-therapy on the thrombocyte count and the agglutination power of thrombocytes was studied continuously in a series of patients. A considerable decrease of the thrombocytes in the third week of treatment was observed, close to the danger of hemorrhage, but being reversed spontaneously at the end of the irradiation. The agglutination power of the thrombocytes is inversely proportional to the total number of thrombocytes. It is increased during irradiation as compared to normal cases. Simultaneous thrombolastographic studies exclude the possibility of marked changes of the plasmatic factors and the blood thromboplastin generation. The studies demonstrate that noxious effects of the gynecological irradiation may only occur on the thrombocytic system. (auth)

14714

THE RESISTANCE OF THE TOLERANT STATE TO X-IRRADIATION. David T. Denhardt and Ray D. Owen (California Inst. of Tech., Pasadena). *Transplantation Bull.* 7, 394-9(1960) Apr.

An experiment was undertaken to see if x irradiation of rabbits would destroy their acquired tolerance to bovine serum albumin (BSA). In no case was tolerance lost. Experiments were then undertaken with these same rabbits to see if they could give an immune response to bovine serum albumin diazotized with sulfanilic acid (S-BSA). It was found that the BSA tolerant animals did not respond to S-BSA. Data are presented graphically. (C.H.)

14715

THE COMBINED ACTION OF BONE MARROW AND STREPTOMYCIN IN PROTECTING NEUTRON-IRRADIATED MICE FROM ACUTE MORTALITY. Howard H. Vogel, Jr. and Donn L. Jordan (Argonne National Lab., Lemont, Ill.). *Transplantation Bull.* 7, 413-15(1960) Apr.

Mice exposed to a single whole-body dose (LD 95/30) of fission neutrons (350 to 360 rads) usually die within 10 days. However, when a single postirradiation injection of isologous bone marrow cells is combined with daily treatment with the antibiotic streptomycin, such neutron-irradiated animals are protected against acute radiation death (88% survival at 30 days). The combined action of the 2 agents probably reflects their protection against damage to different physiological systems. (auth)

14716

THE EFFECT OF X RADIATION ON HEMOGLOBIN (WITH A CONSIDERATION ON THE RADIOSENSITIVITY OF TISSUE SECTIONS). Otto Warburg, Walter Schröder, and H. W. Gattung (Max-Planck-Institut für Zellphysiologie, Berlin-Dahlen). Z. Naturforsch. 15b, 163-6(1960) Mar. (In German)

Methemoglobin formation by x radiation results from the hydrogen peroxide formed in the irradiation. (tr-auth)

Radiation Sickness

14717 JPRS-2254

THE CHANGE IN CERTAIN PHYSICOCHEMICAL PROPERTIES OF BLOOD PLASMA PROTEINS IN ANIMALS IN ACUTE RADIATION SICKNESS. K. V. Gordeeva (Gordeyeva) and A. S. Mozshukhin. Translated from Med. Radiol. 4, No. 10, 13-17(1959). 7p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 4260.

14718 JPRS-L-819-N

THE EFFICACY OF DIFFERENT KINDS OF HEMOTHERAPY IN EXPERIMENTAL ACUTE RADIATION SICKNESS. P. D. Gorizontov and V. D. Rogozkin. Translated from Klin. Med. (U.S.S.R.) 37, No. 4, 11-18(1959). 18p. OTS.

The effectiveness of various kinds of homotherapy against radiation injury was demonstrated in dogs. Results are included on combinations of homotherapy and antibiotics, vitamins, antihistamines, stimulants of hematopoiesis, sedatives, and supplementary protein nutrition. It was concluded that hemotherapy is an important element in the comprehensive therapy of acute radiation sickness. (C.H.)

14719 JPRS-L-835-N

THE EFFECT OF PENTOXYL ON LEUKOPOIESIS IN RADIATION LEUKOPENIA. T. V. Kalyaeva (Kalyayeva). Translated from Patol. Fiziol. i Eksptl'. Terap. 3, 36-9 (1959). 9p. OTS.

The use of pentoxyl in a total dose of 15 mg per kg body weight elicits in healthy rabbits an increase in the number of leukocytes in the peripheral blood, a reduction in the index of young cells of the white series in the bone marrow, and an enhanced degeneration of these cells in the peripheral blood and hematopoietic organs. The use of pentoxyl over the course of three weeks after irradiation does not lead to activation of leukopoiesis in dogs irradiated with doses of 250 and 400 r. Mortality of the animals and the clinical course of radiation sickness were identical in treated and control dogs. The use of pentoxyl increases the degeneration of white blood cells both in healthy and in irradiated animals. Degeneration of cells is greater the higher the dose of pentoxyl administered. We believe that the use of pentoxyl in acute cases of radiation leukopenia is inadvisable. (auth)

14720 JPRS-L-837-N

THE EFFECT OF CERTAIN NEUROTROPIC SUBSTANCES ON REGENERATION OF BONE TISSUE IN ACUTE RADIATION SICKNESS.

N. F. Krut'ko. Translated from Patol. Fiziol. i Eksptl' Terap. 3, 72(1959). 2p. OTS.

A study of the influence of such neurotropic substances as sodium bromide and caffeine on the regeneration of osseous tissue in acute radiation sickness led to the conclusion that acute radiation sickness leads to significant retardation in the regeneration of osseous tissue in rabbits. Sodium bromide showed no positive influence on the course of the radiation sickness or on the rate of bone regeneration. Caffeine exerted a positive influence on the course of radiation sickness. There was an increase in the survival rate of the rabbits, and a normalization of the regenerative process in the osseous tissue. (C.H.)

14721 JPRS-L-903-N

CHANGES IN THE PERIPHERAL NERVOUS SYSTEM OF DOGS IN ACUTE RADIATION SICKNESS CAUSED BY THE INTRAVENOUS ADMINISTRATION OF RADIOACTIVE STRONTIUM. B. I. Lebedev. Translated from Ark. Patol. 21, No. 5, 25-30(1959). 10p. OTS.

In acute radiation sickness produced by the intravenous injection of radioactive strontium, morphological changes of reactive and destructive nature developed in the sensory spinal ganglia, sensory ganglia of the trigeminal and the vagus nerves, extramural sympathetic ganglia, and intramural plexuses of the gastro-intestinal tract. The involvement of the neurons of the nerve structures studied was not uniform: in the sensory ganglia changes in all cases were of a reactive reversible character; in the sympathetic ganglia and in the plexus of Auerbach the changes were more diffuse. At the height of the condition the changes in these structures assumed a destructive nature. Involvement of the nerve elements of the intramural plexuses in the digestive tract was not uniform. The main changes were found in the plexus of Auerbach of the duodenum and jejunum. (auth)

14722 JPRS-L-904-N

THE PROBLEM OF THE THERAPY OF ACUTE RADIATION SICKNESS WITH HOMOPLASTIC TRANSPLANTATION OF THE SPLEEN. M. Ya. Shleyfer. Translated from Patol. Fiziol. i Eksptl'. Terap. 3, 33-6(1959). 6p. OTS.

Transplant of the spleen of a healthy adult donor rabbit into the subcutaneous areolar tissue of a recipient rabbit 24 hours after a single total x irradiation of 1100 r considerably increases survivability and attenuates the course of acute radiation sickness. (auth)

14723 JPRS-L-1821-D

DESOXYRIBONUCLEASE IN URINE IN RADIATION SICKNESS. N. I. Kerova. Translated from Fiziol. Zhur. Akad. Nauk Ukr. R.S.R. 5, 99-100(1959). 6p. OTS.

Exposure of dogs and man to x and gamma radiation resulted in the appearance of desoxyribonuclease in the urine. The urine to be examined was added to a solution of desoxyribonucleic acid and after a certain incubation period the enzyme activity is manifested by the phosphorus formed. The phosphorus is determined by colorimetry. The method requires approximately 3 to 4 hours. Desoxyribonuclease appears in the urine soon after irradiation and is interpreted as an indication of radiation damage to the body. (C.H.)

14724 JPRS-L-1822-D

MORPHOLOGICAL CHANGES IN THE PERIPHERAL NERVOUS SYSTEM OF ANIMALS AT LONG PERIODS AFTER ACUTE RADIATION SICKNESS. T. N. Oleinikova (T. M. Oleynykova). Fiziol. Zhur. Akad. Nauk Ukr. R.S.R. 5, 104-8(1959). 5p. OTS.

Rats which had suffered from acute radiation sickness, due to exposure to doses of 400 to 600 r x radiation or the

injection of radioactive phosphorus, were killed in a state of apparent health at periods ranging from 25 days to one year after irradiation. Morphological changes observed in the peripheral nervous system are described. Morphological changes attributed to radiation injury were observed in all animals. (C.H.)

CHEMISTRY

General and Miscellaneous

14725 GAT-T-797

Goodyear Atomic Corp., Portsmouth, Ohio.

A STUDY OF THE EFFECTIVENESS OF USING A ZINC CHROMATE PRIMER FOR BITUMASTIC PAINT. F. A. Koehler. Apr. 26, 1960. 5p. Contract AT(33-2)-1. OTS.

A study was undertaken to evaluate, under simulated atmospheric conditions, the effectiveness of using a zinc chromate primer for bitumastic paint. Metal test panels were exposed to heat and salt water over a four-day period, and comparisons of primed and unprimed surfaces were made. As a result of the study it was found that by using an undercoating of zinc chromate primer the degree of adhesion and effectiveness of an aluminum-filled bitumastic paint are noticeably enhanced. (auth)

14726 NP-8562

Hughes Aircraft Co. Microwave Lab., Culver City, Calif. RESEARCH ON HIGH TEMPERATURE POLYMERS. Technical Report No. 3 [for Period] March 1 through September 1, 1959. J. B. Rust, C. L. Segal, and H. H. Takimoto. 124p. Contract Nonr-2540(00).

The alkoxyacyloxy reaction was utilized to prepare a number of poly(triorganomethoxy)metalloxane polymers. Polymers containing tin in the linear polymer chain or in the side group were also prepared by the alkoxyacyloxy reaction. Poly(chelated)metalloxane polymers were prepared by the alkoxyacyloxy reaction, or by controlled hydrolysis of specific intermediates. The extent of undesirable side reactions in the formation of metalloxane polymers by the alkoxyacyloxy reaction was determined from the results of chemical analysis of the products and by-products. (For preceding period see NP-7605.) (W.L.H.)

14727 NYO-2525

Radiation Applications Inc., New York.

QUARTERLY SUMMARY REPORT FOR THE PERIOD JANUARY 1, 1960 TO MARCH 31, 1960. 3p. Contract AT(30-1)-2318. OTS.

Methanol was found to greatly accelerate the grafting of styrene to nylon. Methanol was also found to accelerate the grafting of styrene to low-density polyethylene. (W.L.H.)

14728 ORNL-2927

Oak Ridge National Lab., Tenn.

INVESTIGATION OF SPECTROCHEMICAL SOLUTION-METHODS OF ANALYSIS. THE USE OF DESIGNED EXPERIMENTS AND STATISTICAL METHODS OF ANALYSIS IN THE INTERPRETATION OF DATA. J. A. Norris and Roberta L. McCutchen. May 9, 1960. 37p. Contract W-7405-eng-26. OTS.

During a period of 12 months, 46 systems for introducing a liquid sample into the spark-gap of a spectrograph were studied by means of eight designed experiments. Such factors as types and sources of electrodes, signal-to-noise ratios, number of exposures per electrode, et cetera, were included in this investigation. Statistical techniques were used to evaluate the 30,000 measurements that were secured in these investigations. As a result of this work, the

electronic system of the spectrograph was modified to provide for an automatic compensating system and optimum conditions for introducing a liquid into the spark-gap were tentatively established for the rotating-disk electrode system. (auth)

14729 PRL-5.28

Pennsylvania State Univ., University Park. Petroleum Refining Lab.

FLUIDS, LUBRICANTS, FUELS AND RELATED MATERIALS. Quarterly Report for July, August, and September 1959. Sept. 30, 1959. Appendix I: SURVEY OF HYDRAULIC FLUIDS, LUBRICANTS, AND WORKING FLUIDS FOR AERONAUTIC AND ASTRONAUTIC APPLICATIONS. M. R. Fenske and E. E. Klaus. Nov. 2, 1959. (PRL-10-59). 133p. Contract AF33(616)-5460.

Results obtained in a Vickers pump test program in which a prototype mineral oil designed for operation at -65 to +700°F are discussed. The fluid (MLO-7460) used in this program exhibits the same general high temperature lubricity and stability behavior as the low temperature fluid (MLO-7485). However, this fluid contains wax and does not have the same low temperature properties as those of MLO-7485. Preliminary evaluation of several fluids which were stored in an unheated building for 2 to 17 years was carried out. Included in the evaluation were esters, mineral oils, and hydrocarbons, as well as formulations using these materials as base stocks. Changes in properties were noted and evidence is presented to show that additives may adversely affect storage stability in some cases. Data from a series of oxidation tests involving esters at 400°F are presented along with a discussion of the effectiveness of additives. Assimilation data show a predictable oxygen absorption rate during the stable life period, which is affected by the use of additive combinations. Magnesium corrosion was encountered in the 400°F tests and data on oxidation behavior of this material are included. Effects of a dispersant acryloid and of a dialkyl acid phosphite lubricity additive on fluid dirtiness are discussed. A series of deposition tests was conducted in a controlled atmosphere panel coker. A comparison of paraffinic and naphthenic mineral oil formulations tested in the coker is presented. Decreasing coking tendencies with increasing boiling point is illustrated for a series of oxygen. Assimilation is lower for higher volatility fluids which also show excessive coking. The increased coke deposit caused by the presence of a dithiocarbamate in the test fluid is shown to be materially reduced by the addition of a dispersant acryloid to the formulation. Deposition type tests were conducted in a single-pass high temperature tube rig. The effect of such variables as storage time of flat fluid, acid phosphate additives, fluid volatility, test time, and type of metal deposition surface was determined. (For preceding period see PRL 5.27.) (J.R.D.)

14730 RCTC/P-128

[Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England].

THE PREPARATION OF PLUTONIUM METAL. K. W. Bagnall, T. L. Markin, D. S. Robertson, P. S. Robinson, and M. A. A. Stewart. [nd]. 2p.

Preparation methods for small quantities of plutonium metal without using plutonium fluoride are described. Direct calcium reduction of PuO₂ or Cs₂PuCl₆ appears to be the best method. (J.R.D.)

14731 WADC-TR-59-64(Pt.II)

National Bureau of Standards, Washington, D. C.

THERMAL DEGRADATION OF POLYMERS AT TEMPER-

ATURES UP TO 1200°C. [Period covered] February 1, 1959 to January 31, 1960. Samuel L. Madorsky and Sidney Straus. Mar. 31, 1960. 48p. Project title: NON-METALLIC AND COMPOSITE MATERIALS. Task title: NEW CHEMICALS AND METHODS. Delivery Order No. (33-616)58-8.

Samples of three thermoset plastics, Vibrin, epoxy, and phenolic, and of three high-temperature polymers, poly(vinylidene fluoride), polytrivinylbenzene, and polyacrylonitrile, were pyrolyzed in a vacuum at 1200°C. The relative amounts of gaseous, liquid, wax-like, and solid products were determined. The more volatile products were analyzed in a mass spectrometer, while the less volatile ones were tested for their over-all average molecular weight by microcryoscopy. Chemical analysis was made of the original materials, and also of the residues from pyrolysis at 500, 800, and 1200°C in the case of phenolic resin, poly(vinylidene fluoride), polytrivinylbenzene, and polyacrylonitrile. Pyrolysis of a high molecular weight linear polymethylene was conducted at 500, 800, and 1200°C in a vacuum and in helium, and the volatile products were analyzed by mass spectrometry and cryoscopy. A number of copolymers of styrene with di- or trivinylbenzene in various proportions were pyrolyzed in a vacuum, in the temperature range 346 to 456°C. Measurements were made of rates of thermal degradation, in a vacuum at various temperatures, of all the polymers mentioned above, except polymethylene. The corresponding activation energies calculated from the rates were 36, 51, and 18 kcal/mole, for Vibrin, epoxy, and phenolic resins, respectively, and 48, 31, and 73 kcal/mole for poly(vinylidene fluoride), polyacrylonitrile, and polytrivinylbenzene, respectively. (auth)

14732 WADC-TR-59-761

United States Borax Research Corp., Anaheim, Calif. RESEARCH ON INORGANIC POLYMER SYSTEMS. [Period] covered: July 1, 1958 to December 31, 1959. Allen L. McCloskey, Robert J. Brotherton, William G. Woods, W. David English, James L. Boone, George W. Campbell, Jr., Harry Goldsmith, Marlowe L. Iverson, Herbert C. Newsom, Harold M. Manasevit, and Lowell L. Petterson. Dec. 1959. 300p. Project title: NON-METALLIC AND COMPOSITE MATERIALS. Task title: NEW CHEMICALS AND METHODS. Contract AF33(616)-5931. OTS.

Investigations on the chemistry of thermally stable inorganic and semi-inorganic polymer systems showing promise of utility at 1000°F are reported. Systems based on B-B, B-N, and Al-O bonding have been studied as well as polymers based on tin, on polyvalent metal salts, and on pi-bonded and coordination compounds. (auth)

14733 JPRS-2508

INVESTIGATION OF THE URANYL NITRATE COMPLEXES WITH DIETHYL ETHER. V. Vdovenko, M. P. Koval'skaya, and T. V. Kovaleva. Translated from *Zhur. Neorg. Khim.* 2, 1677-81(1957). 9p. OTS.

The solubility of $\text{UO}_2(\text{NO}_3)_2$ in anhydrous $(\text{C}_2\text{H}_5)_2\text{O}$ was studied and the composition of the solid phase in equilibrium with the saturated solution was determined. The heats of dissolution of $\text{UO}_2(\text{NO}_3)_2$ in H_2O and in $(\text{C}_2\text{H}_5)_2\text{O}$ were determined to give information as to energy requirements involved. It was found that the heat of solution for $\text{UO}_2(\text{NO}_3)_2$ hydrates was 3.5 kcal/mole for the first water of hydration but dropped to 3.25 and 2.4 kcal for the dihydrate and hexahydrate. It was concluded that the first 4 water molecules are more firmly bound. The heat of hydration of ether is +0.5 kcal for the first H_2O and +2.1 for the second and third, leading to the conclusion that H_2O is more firmly held by the $\text{UO}_2(\text{NO}_3)_2$. (T.R.H.)

14734 NASA-TT-F-21

LUBRICATING OILS FOR AVIATION GAS TURBINES. V. V. Panov and Yu. S. Sobolev. Translated from a publication of the State Scientific and Technical Publishing House of the Petroleum and Mineral-Fuel Industry, U.S.S.R. 82p. OTS.

The ultimate serviceability of gas turbine engine lubricating oils is assessed on the basis of results of tests on individual frictional assembly installations of engines and on full-scale engines. In certain cases, oils are tested under in-flight conditions. (auth)

14735 UCRL-Trans-528

PHOTOELECTRONICS OF ORGANIC COMPOUNDS. A. N. Terenin. Translated from *Radiotekh. i Elektron.* 1, 1127-34 (1956). 16p. JCL or LC.

A survey of data on the photoionization of organic dyes is presented. A new viewpoint on the nature of photoconductivity of dyes is proposed. (auth)

14736

INFRARED SPECTROSCOPY IN H_2O , D_2O AND CH_3OH . Frederick C. Nachod and C. M. Martini (Sterling-Winthrop Research Inst., Rensselaer, N. Y.). *Appl. Spectroscopy* 13, 45-7 (1959).

Infrared spectroscopy in water and alcohol solutions was investigated using silver chloride, teflon, arsenic modified selenium (Kodak) glass, arsenic trisulfide glass (Servofrax), barium fluoride, and sodium chloride cuvettes. A 2 mm blank of Kodak glass gives 70% transmission and affords an opportunity for obtaining rigid, fixed-path cells at a moderate cost. The BaF_2 cells make possible quantitative determinations at 2% reliability, but cost \$180 each and are soluble in acids. For the limited wavelength range 2 to 9 μ the Servofrax glass is used in standard spectrophotometers. A portion of Blounts infrared spectra of a 7% solution of sodium deoxyribonuclease in D_2O is illustrated. Spectra are given for H_2O , methanol, teflon, D_2O , and transmissions for Kodak selenium and silver chloride. (B.O.G.)

14737

REDUCTION WITH METAL HYDRIDES. VIII. REDUCTIONS OF KETONES AND EPIMERIZATION OF ALCOHOLS WITH LITHIUM ALUMINUM HYDRIDE-ALUMINUM CHLORIDE. Ernest L. Eliel and Mark N. Rerick (Univ. of Notre Dame, Ind.). *J. Am. Chem. Soc.* 82, 1367-72(1960).

Whereas lithium aluminum hydride (LAH) reduced 4-t-butylcyclohexanone to a mixture of 90% trans-4-t-butylcyclohexanol and 10% cis-4-t-butylcyclohexanol, LAH- AlCl_3 (1:4 ratio) yields 80% trans- and 20% cis-alcohol under kinetically controlled conditions. Addition of excess ketone or acetone at the end of the reaction leads to thermodynamic control of the reaction products with conversion of the alcohol mixture to one containing over 99% of the trans isomer in less than fifteen minutes. The fast reaction and overwhelming preponderance of the trans isomer is ascribed to the nature of the species equilibrated which are bulky aluminum complexes, not readily accommodated in the axial position of the cyclohexane ring. The equilibration procedure was utilized to determine the conformational equilibrium values for methyl and phenyl groups. The conformational free energy differences are 1.5 ± 0.1 kcal/mole for methyl and ca. 2.6 kcal/mole for phenyl. (auth)

14738

MERCURY(II) COMPLEXES OF IMIDAZOLE AND HISTIDINE. Philip Brooks and Norman Davidson (California Inst. of Tech., Pasadena). *J. Am. Chem. Soc.* 82, 2118-23(1960) May 5.

The association constants of Hg(II) with imidazole and L-histidine were calculated from potential measurements of a Hg, Hg(II) electrode in solutions containing the complexing agents. For imidazole, the result is $\text{Hg}^{2+} + 2\text{C}_3\text{H}_4\text{N}_2 \rightleftharpoons \text{Hg}(\text{C}_3\text{H}_4\text{N}_2)_2^{2+}$, $K = 10^{16.7} \text{ M}^{-2}$. A solid substance, $\text{Hg}(\text{C}_3\text{H}_3\text{N}_2)\text{ClO}_4 \cdot \text{H}_2\text{O}$, precipitates from solutions at $\text{pH} > 4$. It probably contains an infinite chain of $(\text{C}_3\text{H}_3\text{N}_2\text{Hg})_n^{2+}$. For histidine, the main results are: $\text{Hg}^{2+} + 2\text{L}^- \rightleftharpoons \text{HgL}_2$, $K = 10^{21.2} \text{ M}^{-2}$; $\text{Hg}^{2+} + \text{L}^- + \text{HL} \rightleftharpoons \text{HgL}(\text{HL})^+$, $K = 10^{18.4} \text{ M}^{-2}$; $\text{Hg}^{2+} + 2\text{HL} \rightleftharpoons \text{Hg}(\text{HL})_2^{2+}$, $K = 10^{15.0} \text{ M}^{-2}$; where $\text{L}^- = (\text{C}_3\text{H}_3\text{N}_2)\text{CH}_2\text{CH}(\text{NH}_2)\text{CO}_2^-$ and $\text{HL} = (\text{C}_3\text{H}_3\text{N}_2)\text{CH}_2\text{CH}(\text{NH}_3^+)\text{CO}_2^-$. Because of the tendency of Hg^{2+} to form two bonds in a linear configuration, chelate formation contributes only slightly to the ligand binding by Hg^{2+} . There is also evidence for the complex HgL^+ , with a formation constant of $\sim 10^{16} \text{ M}^{-1}$ (from L^-). (auth)

14739

COMPLEXES OF MERCURY(I) WITH POLYPHOSPHATE AND DICARBOXYLATE ANIONS AND MERCURY(II) PYRPHOSPHATE COMPLEXES. Tetsuo Yamane and Norman Davidson (California Inst. of Tech., Pasadena). *J. Am. Chem. Soc.* **82**, 2123-9(1960) May 5.

Mercurous mercury forms complexes with pyrophosphate, tripolyphosphate, oxalate, α -dimethylmalonate, and succinate. These complexes are stable toward disproportionation to mercury(II) complexes and mercury. If L^- is the anion, the principal complexes are $\text{Hg}_2\text{L}_2^{2q+2}$ and $\text{Hg}_2\text{L}(\text{OH})^{q+1}$. The formation constants determined from the potential of a mercury-mercurous electrode in ligand solutions are: $\text{Hg}_2(\text{P}_2\text{O}_7)_2^{8-}$, $(2.4 \pm 0.6)10^{12}$; $\text{Hg}_2(\text{OH})\text{P}_2\text{O}_7^{4-}$, $(4.4 \pm 0.6)10^{15}$; $\text{Hg}_2(\text{P}_3\text{O}_{10})_2^{5-}$, $(1.7 \pm 0.3)10^{11}$; $\text{Hg}_2(\text{OH})\text{P}_3\text{O}_{10}^{3-}$, $(1.0 \pm 0.2)10^{15}$; $\text{Hg}_2(\text{C}_2\text{O}_4)_2^{4-}$, $(9.5 \pm 0.2)10^6$; $\text{Hg}_2(\text{OH})\text{C}_2\text{O}_4^{2-}$, $(1.1 \pm 0.2)10^{13}$; $\text{Hg}_2[(\text{CH}_3)_2\text{C}(\text{CO}_2)_2]_2^{2-}$, $(3.3 \pm 0.6)10^7$; $\text{Hg}_2(\text{OH})[(\text{CH}_3)_2\text{C}(\text{CO}_2)_2]^-$, $(3.8 \pm 0.5)10^{13}$; $\text{Hg}_2[(\text{CH}_3)_2(\text{CO}_2)_2]_2^{2-}$, $(1.9 \pm 0.3)10^7$; $\text{Hg}_2(\text{OH})[(\text{CH}_3)_2(\text{CO}_2)_2]^-$, $(2.8 \pm 0.6)10^{13} \text{ M}^{-2}$. (The ionic strength was 0.75 M (NaNO₃), except for oxalate and succinate, where it was 2.5 M (NaNO₃).) The mercurous compounds have a characteristic ultraviolet spectrum. Mercurous complexes of ligands (such as NH_3 and CN^-) which form strong covalent bonds to mercury are unstable toward disproportionation to give mercuric complexes but "ionic" chelating ligands can form stable mercurous complexes. The mercury(II) pyrophosphate complex was studied from the potential of a Pt electrode in $\text{Hg}_2(\text{I})$, $\text{Hg}(\text{II})$, pyrophosphate solutions at pH 7 to 10. The principal species is $\text{Hg}(\text{OH})(\text{P}_2\text{O}_7)^{3-}$, with a formation constant of $(2.8 \pm 0.6)10^{17} \text{ M}^{-2}$. (auth)

14740

ARYLBORONIC ACIDS. IV. REACTIONS OF BORONOPHTHALIDE. W. J. Lennarz and H. R. Snyder (Univ. of Illinois, Urbana). *J. Am. Chem. Soc.* **82**, 2172-5(1960) May 5.

The preparation of derivatives of boronophthalide is reported. The product of nitration of boronophthalide, 5-nitroboronophthalide, is reduced to 5-aminoboronophthalide. 5-Aminoboronophthalide is converted to N-succinyl-5-aminoboronophthalide and to boronophthalide-5-diazonium chloride. The diazonium compound is coupled with 3-carboxy-2-naphthol. Several attempted transformations of the boronolactone ring of boronophthalide are discussed. (auth)

14741

ARYLBORONIC ACIDS. III. PREPARATION AND POLYMERIZATION OF p-VINYLBENZENEBORONIC ACID. W. J. Lennarz and H. R. Snyder (Univ. of Illinois, Urbana). *J. Am. Chem. Soc.* **82**, 2169-71(1960) May 5.

The preparation of p-vinylbenzeneboronic acid by

means of the Grignard reaction is discussed. Poly-p-vinylbenzeneboronic acid is obtained upon free radical initiated polymerization of p-vinylbenzeneboronic acid in aqueous solution. (auth)

14742

LIQUID SCINTILLATORS. XI. 2-(2-FLUORENYL)-5-ARYL-SUBSTITUTED OXAZOLES AND 2-(2-FLUORENYL)-5-PHENYL-1,3,4-OXADIAZOLE. Martin D. Barnett, Guido H. Daub, F. Newton Hayes, and Donald G. Ott (Univ. of New Mexico, Albuquerque and Los Alamos Scientific Lab., N. Mex.). *J. Am. Chem. Soc.* **82**, 2282-5(1960) May 5.

Fluorene-2-carboxylic acid was prepared, either by treatment of 2-acetylfluorene with one equivalent of iodine in excess pyridine followed by basic cleavage of the intermediate pyridinium salt, or by direct carboxylation of fluorene with oxalyl chloride. The reaction of fluorene-2-carbonyl chloride(I) with the appropriate α -aminoketone salt gave 1-(2-fluorenyl)-4-aryl-2-aza-1,4-butanediones which were cyclized to the respective oxazoles with phosphorus oxychloride. 2-(2-Fluorenyl)-5-phenyl-1,3,4-oxadiazole was prepared by cyclization of 1-benzoyl-2-(fluorene-2-carbonyl)-hydrazine, obtained by the reaction of I with benzoylhydrazine. The oxazoles and oxadiazole were evaluated as primary liquid scintillation solutes. In addition, 5-(4-biphenyl)-2-(2-fluorenyl)-oxazole, 2-(2-fluorenyl)-5-(1-naphthyl)-oxazole and 2-(2-fluorenyl)-5-(2-naphthyl)-oxazole were screened as potential secondary solutes. The compounds exhibited excellent scintillation characteristics. (auth)

14743

INVESTIGATION OF THE RADICAL STRUCTURE OF SUBSTANCES PRODUCED IN THE ALKYLATION OF AROMATIC HYDROCARBONS BY ALCOHOLS IN THE PRESENCE OF BORON TRIFLUORIDE. Yu. P. Egorov, I. A. Romadan, Y. A. Shlyapochnikov, and N. I. Shuikin. *Zhur. Fiz. Khim.* **34**, 888-93(1960) Apr. (In Russian)

On the basis of an investigation of the infrared absorption spectra in the CH frequency region, it is possible to determine the radical structure of compounds of the type Ar-R, where Ar is phenyl, diphenyl, or naphthyl and R an alkyl group from C₃ to C₆. (auth)

Analytical Procedures

14744 NP-8666

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

SPECTROGRAPHIC DETERMINATION OF BERYLLIUM TRACES IN ORES BY MEANS OF THE SIFTER ELECTRODE. (Spektrograficzne Oznaczanie Śladów Berylum w Rudach za Pomocą Elektrody Sitowej). Report No. 132/VIII. J. Czakow and Z. Walewska. Jan. 1960. 11p.

A semiquantitative spectrographic extrapolation method of determining beryllium traces in uranium ores is presented. Lines of beryllium 3130.4 Å and V 3110.7 Å were used. The samples were excited in a spark using a tri-arc sifter electrode made of electrolytic copper. Line intensity was corrected for the background. Range of the determinations is 1 to 20 p.p.m. Coefficient of variation is $\pm 8.2\%$. (auth)

14745 JPRS-2261

SPECTROGRAPHIC ANALYSIS OF RARE EARTH ELEMENTS. P. M. Polyakov and A. K. Rusanov. Translated from *Zavodskaya Lab.* **23**, 564-9(1957). 13p. OTS.

Methods are described for the spectrographic determi-

nation of rare earth elements in mixtures and admixtures. (C.H.)

14746

STUDY OF SOME THERMAL CONDUCTIVITY CELLS WITH RESPECT TO THEIR UTILIZATION FOR THE ANALYSIS OF ISOTOPES. R. Bucur, I. Mercea, and V. Mercea. *Acad. rep. populare Romîne, Inst. fiz. atomică și Inst. fiz. Studii cercetări fiz.* 10, 753-70(1959). (In Rumanian)

After a brief discussion of the principle of the method of analyzing binary gas mixtures, a systematic study is made to increase the sensitivity of this method by convenient construction of conductivity cells with an ordinary electric set-up. The characteristics of four different types of sensitive resistances having the same chemical value but being arranged differently in order to vary the "geometric constant" of the cell are given. The sensitivity of the four types of bridges obtained with these resistances is compared with a hydrogen-methane mixture using hydrogen as the reference gas. The sensitivity obtained is very high, permitting the detection of a variation relative to the thermal conductivity of the order of 10^{-5} . The operational stability was studied as a function of the variation of the gas input, of the temperature of the measurement resistances, of the temperature of the analysis block, and of the pressure in the cells. In calculating the possibility of using this apparatus to analyze isotopes in the mixtures H_2 -HD, O^{16} - O^{18} , N^{14} - N^{15} , and Ne^{20} - Ne^{22} , it was concluded that the sensitivity of the bridge allows the determination of the natural abundance of the isotopes. (tr-auth)

14747

DETERMINATION OF ZIRCONIUM IN PLUTONIUM BY ION EXCHANGE AND SPECTROGRAPHY. Roy Ko (General Electric Co., Richland, Wash.). *Appl. Spectroscopy* 13, 10-11(1959).

The spectrographic analysis of plutonium for impurity elements is not without difficulties due to the complex emission spectrum of plutonium and to its toxicity. Separating the plutonium from the elements of interest would reduce the spectral interference and health hazard. In the determination of zirconium in plutonium, the plutonium was separated from zirconium by retaining the plutonium as a nitrate complex on the anion exchange resin, Dowex-1, while collecting the zirconium in the effluent and wash solution. The combined effluent and wash solutions were evaporated to a small volume and the resulting solution analyzed for zirconium by graphite spark excitation using cobalt as the internal standard. Concentrations as low as 20 ppm of zirconium in plutonium have been determined with a precision of $\pm 17\%$ (95% c.l.) for a single measurement. (auth)

14748

THE SPECTROCHEMICAL ANALYSIS OF SUPER PURE CHROMIUM FOR IMPURITIES. C. G. Baird (Defence Standards Labs., Maribyrnong, Victoria, Australia). *Appl. Spectroscopy* 13, 29-31(1959).

A method is described for the spectrochemical analysis of super pure chromium for six impurity elements. The chromium is removed by volatilization as chromyl chloride and the impurities collected on a calcium sulphate matrix. This is burned in a d-c arc and the intensities of the impurity lines are measured with reference to indium, which is added as an internal standard. Working curves are shown for the six elements, Mg, Pb, Fe, Al, Cu, and Ag in the concentration range 0.005-0.0001%. Results are given of a typical analysis and the standard deviations. (auth)

14749

DETERMINATION OF MAJOR CONSTITUENTS IN ALLOY STEELS BY SPECTROGRAPHIC SOLUTION METHODS. C. A. Waggoner (Pacific Naval Lab., Esquimalt, British Columbia). *Appl. Spectroscopy* 13, 31-3(1959).

A spectrographic solution technique utilizing either the porous cup or rotating disk electrode may be used to analyze high-alloy steels such as the corrosion and heat-resisting alloys, including the iron-chromium, iron-chromium-nickel, and iron-nickel-chromium groups. Some types of low-alloy steel may be analyzed from the same analytical curves. Cobalt is added as an internal standard, and iron, chromium, nickel, manganese, and molybdenum are determined with an accuracy in the order of ± 2 to 3% of the amounts present. Interelement effects arising from wide variations in composition were indicated to be negligible. The procedure outlined is designed primarily for alloy identification or specification analysis, and is particularly useful where sample dimensions are not uniform. (auth)

14750

A METHOD FOR THE SPECTROGRAPHIC DETERMINATION OF TRACE IMPURITIES IN NIOBIUM. D. E. Fornwalt and M. K. Healy (Pratt and Whitney Aircraft Div., Middletown, Conn.). *Appl. Spectroscopy* 13, 38-40(1959).

A method is described for the spectrographic determination of 14 elements present in niobium. The elements determined and their concentration ranges include: boron, 0.0001 to 0.0015%; aluminum, cadmium, chromium, cobalt, iron, manganese, molybdenum, nickel, silicon, tin, and titanium, 0.001 to 0.1%; tantalum, 0.025 to 1.5%; and zirconium, 0.001 to 1.5%. The analysis involves the conversion of niobium to the oxide by heating the metal in platinum at 800°C until oxidation is complete. A 10 mg sample plus 10 mg of lithium carbonate, as a spectrographic buffer, and 25 μ g of lanthanum, as an internal standard, is excited in a 20-amp d-c arc. The spectrogram obtained is used for the determination of all the elements listed with the exception of aluminum, boron, silicon, zirconium, and tantalum. The latter are determined from a spectrogram obtained by the excitation of a separate 20 mg sample of niobium oxide. The coefficient of variation is of the order of 10% for the various impurities. (auth)

14751

A COMPARISON OF PRECISION FOR SOLID, LIQUID AND POWDER SAMPLING TECHNIQUES IN THE X-RAY FLUORESCENCE ANALYSIS OF HIGH TEMPERATURE ALLOYS. Stanley Friedlander and Alan Goldblatt (Chicago Spectro Service Lab., Inc., Chicago). *Appl. Spectroscopy* 13, 91-3(1959).

Data obtained in the routine use of a multi-channel x-ray spectrometer are presented to demonstrate precision on stainless steel, nickel, and cobalt base alloys as solids, liquids, and briquetted powders. Coefficients of variation of 0.5% and less for the major constituents in high-temperature alloys are readily attainable. The combination of liquid and powder techniques is particularly significant in that it provides an independent method for standardizing complex alloys by use of synthetic standards. (auth)

14752

OPTICAL SPECTROGRAPHIC DETERMINATION OF ALUMINUM IN A TITANIUM ALLOY. E. F. Runge and F. R. Bryan (Ford Motor Co., Dearborn, Mich.). *Appl. Spectroscopy* 13, 116-19(1959).

The control analysis of titanium alloys has not reached the degree of speed and perfection possible with corre-

sponding alloys of aluminum, magnesium, and steel. Nearly all reliable methods for titanium have necessitated reducing the samples to chips and dissolving the metal prior to either chemical or spectrochemical analysis. These procedures are time consuming and costly. Most attempts to analyze titanium alloys by direct metal excitation have resulted in abnormally high errors frequently attributed to metal segregation. Results of experiments in this laboratory indicate that acceptable precision can be obtained on a typical commercial alloy by direct excitation if certain precautionary techniques are employed. These techniques involve; (1) selection of homologous line pairs, (2) choice of a reference line close to the element line in wavelength, (3) provision for flushing the analytical gap with an inert atmosphere during excitation, and (4) use of an adequate pre-exposure period to provide an equilibrium condition during exposure. The procedural considerations described, when applied to a direct spectrographic method, can reduce errors by an order of magnitude in the case of aluminum determinations in titanium alloy. The precision obtainable provides a coefficient of variation of 0.9%. (auth)

14753

SPECTROGRAPHIC ANALYSIS OF AIR SAMPLES FOR BERYLLIUM CONTAMINATION. M. P. Brash (Avco Corp., Wilmington, Mass.). Appl. Spectroscopy **14**, 43-5 (1960).

A spectrographic technique for the determination of beryllium in atmospheric dust has been developed. Both a permanently installed low volume air sampler and a portable high volume sampler are employed for obtaining the air-borne dust samples. Solutions of the filtering media are used for spectrographic analyses, by a solution-spark technique using a rotating disk electrode. The method is sensitive to 0.05 μg beryllium per cubic meter of air, with a coefficient of variation of less than 11% in the 0.5 to 2 μg range. (auth)

14754

THE DETERMINATION OF BERYLLIUM METAL IN AIR. R. J. Powell, P. J. Phennah, and J. E. Still (General Electric Co., Ltd., Wembley, Eng. and General Electric Co., Ltd., Atomic Energy Div., Erith, Eng.). Analyst **85**, 347-54(1960) May.

Methods are described for the sampling and testing of air in a laboratory designed and equipped for work on beryllium metal. A suitable volume of air is drawn through a filter-paper. The paper is destroyed by wet oxidation, and any beryllium present is collected by coprecipitation, redissolved and determined on a direct-reading spectrograph. The method is shown to be satisfactory over the range 0.015 to 50 μg of beryllium. The total time required for testing twenty samples is about 4½ hours. (auth)

14755

A POSSIBLE USE OF AMMONIUM 12-MOLYBDOPHOSPHATE FOR ASSAYING CERTAIN RADIOACTIVE FISSION PRODUCTS IN WATER. R. W. C. Broadbank, S. Dhabanandana, and R. D. Harding (Coll. of Tech. and Commerce, Leicester, Eng.). Analyst **85**, 365-70(1960) May.

Many cations, including those of cesium-137/barium-137m, strontium-90/yttrium-90, and cerium-144/praseodymium-144, are efficiently removed from neutral solution by a pre-formed precipitate of ammonium 12-molybdophosphate supported on a filter-paper in a demountable funnel. Cesium is selectively taken up by this compound from dilute nitric acid solution, and a method based on this fact is suggested for the quantitative determination of radioactive cesium. (auth)

14756

THE APPLICATION OF RADIOACTIVITY IN CHEMICAL ANALYSIS. T. Schönfeld and E. Broda (Universität, Vienna). Atompraxis **3**, 77-80(1957). (In German)

A general survey is made of the application of radioactivity to chemical analyses. The advantage of radioactivity is first briefly discussed. The types of application are then tabulated. These include natural radioactivity, tracer analysis, analysis with radioactive reagents, isotopic dilution analysis, activation analysis, and absorption and scattering analysis. The sources of error in the application of these methods are considered. Each method is then discussed in detail and examples are given. 301 references. (J.S.R.)

14757

THE GAS CHROMATOGRAPHIC DETERMINATION OF HYDROGEN, DEUTERIUM AND HD. W. A. Van Hook and Paul H. Emmett (Johns Hopkins Univ., Baltimore). J. Phys. Chem. **64**, 673-5(1960) May.

Gas chromatographic analyses of mixtures of H_2 , D_2 , and HD with an activated alumina column at -195°C and helium as carrier gas yielded peaks for $p\text{-H}_2$, $o\text{-H}_2 + \text{HD}$, and D_2 . If either the $o\text{-H}_2/p\text{-H}_2$ or HD/D_2 ratio is known, quantitative analysis of such mixtures can be made where the HD concentration is more than 10%. In the case where neither ratio is known, peaks for HD and D_2 can be obtained by using a molecular sieve column and H_2 as carrier gas, which eliminates the $o\text{-H}_2$ and $p\text{-H}_2$ peaks. (D.L.C.)

14758

ON THE SEPARATION OF VANADIUM, MOLYBDENUM AND TUNGSTEN BY MEANS OF PAPER CHROMATOGRAPHY. [PART] I. Shih-fu Tzou and Shu-chuan Liang (Inst. of Chemistry, Academia Sinica, Peking). Sci. Sinica (Peking) **8**, 196-200(1959) Feb. (In English)

Molybdenum, tungsten, and vanadium are separated by chromatography as per-acids, and then detected with tannin solution. Of the seven solvents tested, *n*-butanol-hydrogen peroxide-nitric acid mixtures offer the best separations. With the addition of dioxane, the R_f values of these elements increase, while vanadium and tungsten spots overlap. The formation of per-acids avoids the re-tainment of tungsten on the original spot and the tailings of vanadium and molybdenum spots. (B.O.G.)

14759

THE ANALYTICAL CHEMISTRY OF THORIUM. 1. HOMOGENEOUS PRECIPITATION OF THORIUM SELENITE AND VOLUMETRIC DETERMINATION OF THORIUM. Jen-yin Yen, Kuang-hua Djao, and Feng-chiao Hsiao (Peking Univ.). Sci. Sinica (Peking) **8**, 727-32(1959) July. (In English)

Crystalline thorium selenite was obtained by hydrolysis of acetamide and slow neutralization of nitric acid solution. The method is simple and accurate to 0.1 mg for 50 mg of ThO_2 or less. Up to ten-fold the weight of thorium, rare earth oxides can be tolerated provided that the pH value is carefully controlled. (B.O.G.)

14760

THE DETERMINATION OF MOLYBDENUM AND TUNGSTEN. XI. 4-AMINO-4'-CHLORODIPHENYL AS PRECIPITANT. Shu-chuan Liang and Shun-jung Wang (Inst. of Chemistry, Academia Sinica, Peking). Sci. Sinica (Peking) **8**, 990-6(1959) Sept. (In English)

4-Amino-4'-chlorodiphenyl was used to precipitate molybdenum(VI) and tungsten(VI). The pH ranges were 1.8 to 2.8 and 1.5 to 3.1, respectively. According to the thermolysis curve obtained, the tungsten precipitate should be ig-

nited to the trioxide at 625 to 850°C. The use of this reagent for Mo(VI) determination is promising, though its precipitate is more soluble than the corresponding tungstate. (B.O.G.)

14761

A NEW RAPID METHOD FOR DETERMINING THORIUM IN THE PRESENCE OF ZIRCONIUM, IRON, LANTHANUM, URANIUM AND OTHER HEAVY METALS. R. Přibil and K. Burger (Chemical Inst., Czechoslovak Academy of Science, Prague). *Talanta* 4, 8-12(1960) Mar. (In German)

A new procedure for the complexometric determination of thorium has been worked out. Thorium-complexone is decomposed below pH 1 by sodium sulfate, and the liberated complexone-III can then be titrated with bismuth nitrate solution using Xylenol Orange as indicator. The procedure may be used in the presence of large amounts of zirconium, iron, lanthanum, uranium, manganese, and magnesium, as well as smaller amounts of cobalt and nickel. (auth)

14762

THE ANALYSIS OF BERYLLIUM AND BERYLLIUM OXIDE. I. THE DETERMINATION OF IRON. J. O. Hibbits, W. F. Davis, and M. R. Menke (General Electric Co., Evendale, Ohio). *Talanta* 4, 61-6(1960) Mar. (In English)

The importance of beryllium and beryllium oxide to the atomic energy program has necessitated the development of accurate methods of chemical analysis for the determination of metallic impurities. A method is presented for separating iron by extraction with tri-n-octylphosphine oxide followed by determination with 1:10-phenanthroline. The method is accurate to $\pm 3\%$ or ± 3 micrograms of iron, whichever is greater. The accuracy and sensitivity could be increased by appropriate choice of sample weight, volume of extract, and/or cell length. Of the 68 elements investigated, 61 do not interfere in 10-mg amounts. No interference is caused by 5 mg of silicon, 1 mg of antimony, gallium, molybdenum, or tungsten, or 0.1 mg of tellurium or uranium. Only gallium, tellurium, and silicon interfere without producing a warning turbidity in the colored solution. (auth)

14763

SPECTRAL DETERMINATION OF RARE EARTH ELEMENTS IN ORE DEPOSITS. A. N. Zaidel', Z. N. Fafurina, P. P. Yakimova, and S. S. Yakovleva. *Vestnik Leningrad Univ., Ser. Fiz. i Khim.* 15, No. 4, 48-59(1960). (In Russian)

A method of spectral determination for rare earth elements in minerals and ores is described. The spectral analysis of the concentrate is made after chemical separation of the total rare earths and extraction of cerium. The precision is about 20%. The "KSA-1" spectrograph was used. The samples were excited by an a-c arc in CO₂. By determining the yttrium earths in some cerium minerals, the rare earth elements were divided into two fractions by ion-exchange resins. The method was tested on numerous minerals, and the results of x-ray, chromatographic, and spectral analyses were compared. (B.O.G.)

14764

ADSORPTION OF URANIUM FROM ALCOHOLIC CHLORIDE SOLUTIONS ON STRONGLY BASIC DOWEX-1 ANION EXCHANGER. DETERMINATION OF MICROGRAM QUANTITIES OF URANIUM IN SOLID SAMPLES. J. Korkisch, P. Antal, and F. Hecht (Universität, Vienna). *Z. anal. Chem.* 172, 401-8(1960). (In German)

An ion exchange method is given for determination of U both in tungsten-containing minerals and tungsten-free minerals by a column process with high accuracy. Uranium forms a negatively charged chloride complex in a mixture of 20% 4N HCl and 80 to 95% EtOH which is retained on Dowex-1 when most elements are not. Iron(III) ions present are reduced by ascorbic acid. The U is eluted with ether-saturated 0.1N HCl. (T.R.H.)

14765

THE CHEMICAL ANALYSIS OF AIR POLLUTANTS. Morris Boris Jacobs. Chemical Analysis. A Series of Monographs on Analytical Chemistry and Its Applications. Volume X. New York, Interscience Publishers, Inc., 1960. 448p.

A fundamental function in the control of air pollution is the determination of the kind and amount of contaminants. The methods used to accomplish this are described and arranged systematically: general methods for sampling; procedures for determination of air and gas volume, quantity, and velocity; analysis of settled and suspended particulate matter; and methods for the analysis of gaseous and vapor contaminants, including radiochemical methods. Methods are given for the determination of the amount of pollution emitted by a given source and to evaluate the efficiency of abatement devices. Many simple and inexpensive methods of analysis are included, especially for the community or firm having pollution problems and lacking funds to provide the elaborate techniques to cope with the problems. The methods detailed for odor analysis have a wider scope than air pollution control alone. It is stated that this text can readily be adapted for the training of personnel in air pollution control. (B.O.G.)

General Inorganic and Physical Chemistry

14766 NP-8638

Florida. Univ., Gainesville.

FLUOROCARBON NF COMPOUNDS. Quarterly Technical Report No. 3 [for] January 1, 1960 through March 31, 1960. J. A. Young and R. D. Dresdner. 16p. Contract DA-01-009-ORD-772.

Laboratory preparation of N₂F₄ is described and reactions with glass and mercury are reported. In other experiments the reaction of perfluoropiperidine with perfluoropropene was observed to determine the liability of the N-F fluorine in a fluorocarbon ring compound. Preliminary information is also given on indirect fluorination of fluorocarbon nitrogen compounds and replacement of acyl groups on nitrogen by fluorine. Preparation of various other nitrogen containing fluorocarbons is discussed. (J.R.D.)

14767 NYO-7432

Carnegie Inst. of Tech., Pittsburgh. Metals Research Lab. THE STANDARD FREE ENERGY OF FORMATION OF CERTAIN RARE EARTH CARBIDES. Final Report. C. L. McCabe. Mar. 31, 1960. 40p. Contract AT(30-1)-1825. OTS.

The carbide phase present at equilibrium in the system M-H₂-CH₄ was shown to be MC for the rare earth metals Ce and Pr. ΔF_{298}° , ΔH_{298}° , and ΔS_{298}° for the reactions $Ce + C \rightleftharpoons CeC$ and $Pr + C \rightleftharpoons PrC$ were calculated from gaseous equilibrium measurements. (auth)

14768 TID-5913

Tufts Univ., Medford, Mass.

THERMOCRYSTALLOGRAPHY OF THE HYDRIDES OF

TITANIUM, ZIRCONIUM AND HAFNIUM. Edward J. Goon and Joseph Malgiolio. [1959?] 10p. OTS.

A high-temperature x-ray-diffraction study of the dihydrides of zirconium and hafnium has indicated that an apparent second order transformation occurs in the hydrides below critical temperatures of approximately 900 and 407°C, respectively. The low-temperature tetragonal phases are distortions of the high-temperature cubic fluorite phases, and are isomorphous with the tetragonal TiH_2 structure. The tetragonality of the dihydrides is temperature dependent. The variation of the lattice constant of the cubic fluorite lattice of titanium and hafnium hydrides at constant temperature was found to be dependent upon composition of the hydride and hydrogen gas pressure over the specimen in a complex manner. The absorption of hydrogen by the group IVA transition metals to form hydrides and the accompanying crystal structure changes are discussed. (auth)

14769

INFRARED SPECTRA OF METAL NITRATES. Frederick Vratny (Purdue Univ., Lafayette, Ind.). *Appl. Spectroscopy* **13**, 59-70(1959).

The spectra of 35 metal nitrates are presented. A tabulation of observed absorption maxima is made and an interpretation of the spectra provided. This is based on symmetry changes on the nitrate group, resulting from changes in the metal-to-nitrate bond. The compounds are classified as to the degree of ionic or covalent character. (auth)

14770

SPIN LATTICE RELAXATION IN NEODYMIUM ETHYL-SULPHATE AT LIQUID HELIUM TEMPERATURES.

J. M. Daniels and K. E. Rieckhoff (Univ. of British Columbia, Vancouver). *Can. J. Phys.* **38**, 604-15(1960) May.

The optical Faraday effect was used to measure instantaneous magnetization in neodymium ethylsulfate. The spin populations were disturbed by pulses of microwave power, and by adiabatic magnetization and demagnetization, and the approach to equilibrium was studied. The relaxation was found to be exponential and spin lattice relaxation times were measured, for temperatures between 1.3 and 4.2°K, and for magnetic fields between 80 and 6000 gauss. The relaxation time was found to decrease with increasing magnetic field, and to vary with temperature approximately as $1/T^3$. No dependence of relaxation time on pulse length was found. (auth)

14771

SORPTION OF RADIOACTIVE ISOTOPES ON PRECIPITATES. II. STRONTIUM AND YTTRIUM SORPTION ON IRON(III) AND ALUMINUM HYDROXIDES. Z. Kolařík and V. Kouřim (Czechoslovak Academy of Sciences, Prague). *Collection Czechoslov. Chem. Commun.* **25**, 1000-7(1960) Apr. (In German)

The sorption of various strontium concentrations and yttrium traces on iron(III) and aluminum hydroxide and their back desorption and specifically the effect of hydrogen and ammonium ions on the sorption equilibrium were studied. It was shown that strontium is adsorbed on ferric hydroxide by exchange of the hydrogen ions of the hydroxide. (tr-auth)

14772

DETERMINATION OF THE ION ADSORPTION BY THE RADIOACTIVE TRACER TECHNIQUE. II. Nd-ION ADSORPTION AND COAGULATION OF AgI. M. J. Herak and M. Mirković (Univ. of Zagreb). *Kolloid-Z.* **168**, 139-43(1960). (In English)

The adsorption equilibrium between the negative AgI and the coagulating Nd^{3+} is established in about 30 minutes during the coagulation by the "in statu nascendi" technique. The amount adsorbed of the coagulating ion (Nd^{3+}) is at a given pI value independent of its concentration in the region above its coagulation value. The amount adsorbed of the coagulating ion at a given concentration of it decreases linearly with the pI value. The adsorption capacity (the slope) for the precipitate "in statu nascendi" AgI 10^{-3} M, is 0.25 parts per thousand (mg equiv. $Nd^{3+}/(pI \cdot \text{gmole AgI})$), the extrapolated zero point at about pI = 14.5. On aged precipitates, prepared by mixing of concentrated solutions (0.1 N) the amount adsorbed at a given pI value is for about 2 mg equiv. $Nd^{3+}/\text{gmole of AgI}$ lower (zero point at pI = 5.7). The amount adsorbed of a given ion (Nd^{3+}) at a given concentration depends on the concentration and valency of other desorbing ions present. The logarithm of concentration of the desorbing ion at which 50% of the adsorbed ion is desorbed decreases linearly with the valency of the desorbing ion. The slope is equal to the slope of the linear function of logarithm coagulation value vs. valency of the coagulation ion. The coagulation values of Nd^{3+} on AgI are independent on the pI value, while a slight influence of the pCl and pBr values are observed on the respective precipitates. (auth)

14773

SILICATES OF RARE-EARTH ELEMENTS. I. CONSTITUTION DIAGRAM OF $La_2O_3-SiO_2$. N. A. Torpov and N. A. Bondar (Inst. of Silicate Chemistry, Academy of Sciences, USSR). *Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk* No. 2, 153-6(1960) Feb. (In Russian)

Studies were made of the $La_2O_3-SiO_2$ constitution diagram, and the composition and temperatures of invariable points on the diagram were determined. The compound $2La_2O_3 \cdot 3SiO_2$ was synthesized, and the boundary of stratification was determined. (R.V.J.)

14774

THE FARADAIC ADMITTANCE OF ELECTROCHEMICAL PROCESSES. II. EXPERIMENTAL TEST OF THE THEORETICAL EQUATIONS. Henry H. Bauer, David L. Smith, and Philip J. Elving (Univ. of Michigan, Ann Arbor). *J. Am. Chem. Soc.* **82**, 2094-8(1960) May 5.

The two equations obtained to describe the behavior of a simple oxidation-reduction reaction under the influence of a small superposed alternating potential are evaluated. The cadmium system, which is the most thoroughly studied system, was investigated under a variety of conditions. While either equation may be applicable to results for a particular system involving fixed concentration of depolarizer and background medium over a narrow frequency range, neither equation is of general applicability, e.g., neither describes satisfactorily the observed variation of the phase angle and hence of the heterogeneous rate constant with frequency and depolarizer concentration. The difficulties would seem to be associated with the use of invalid postulates in setting up the theories which led to the equations. It is suggested that a more rigorous mathematical treatment of the problem would involve consideration of the rectifying properties of the system. (auth)

14775

THE THERMODYNAMIC PROPERTIES OF TECHNETIUM AND RHENIUM COMPOUNDS. VII. HEATS OF FORMATION OF RHENIUM TRICHLORIDE AND RHENIUM TRIBROMIDE. FREE ENERGIES AND ENTROPIES. J. P. King and J. W. Cobble (Purdue Univ., Lafayette, Ind.). *J. Am. Chem. Soc.* **82**, 2111-13(1960) May 5.

The heats of oxidation of $\text{ReCl}_3(\text{c})$ and $\text{ReBr}_3(\text{c})$ by basic hypochlorite were determined. From these data the heats of formation at 25° were calculated to be: $\text{ReCl}_3(\text{c})$, -63.0 ± 0.8 kcal mole $^{-1}$ and $\text{ReBr}_3(\text{c})$, -39.3 ± 0.8 kcal mole $^{-1}$. Free energy and entropy estimates also are given. (auth)

14776

THE PREPARATION OF THE ANHYDROUS ZIRCONIUM TRIHALIDES. I. E. Newnham and J. A. Watts (Commonwealth Scientific and Industrial Research Organization, Melbourne). *J. Am. Chem. Soc.* **82**, 2113-15(1960) May 5.

A new process for preparing pure, anhydrous zirconium trichloride, tribromide, and triiodide is described. The appropriate tetrahalide vapor is mixed with hydrogen at a pressure of 3 to 4 mm and passed through a glow discharge. The zirconium trihalide which is formed is subsequently freed from adsorbed or unreduced contaminants by heating *in vacuo*. (auth)

14777

STABILITIES OF DIVALENT METAL COMPLEXES OF 4-HYDROXYBENZOTHAZOLE. Pao Kuo Feng and Quintus Fernando (Univ. of Pittsburgh). *J. Am. Chem. Soc.* **82**, 2115-18(1960) May 5.

The acid dissociation constants of 4-hydroxybenzothiazole and the formation constants of its chelates with Mn(II) , Co(II) , Ni(II) , Cu(II) , Zn(II) , Cd(II) , Pb(II) , and Mg(II) were determined potentiometrically in 50% v/v dioxane-water. The order of decreasing stability of the metal chelates $\text{Cu} > \text{Pb}$, Ni , $\text{Co} > \text{Zn} > \text{Cd} > \text{Mn} > \text{Mg}$ is similar to the stability sequence generally obtained for divalent metals. The chelates of 4-hydroxybenzothiazole with Co(II) , Ni(II) , Cu(II) , Zn(II) , Cd(II) , and Pb(II) were prepared and their infrared spectra determined. (auth)

14778

WETTING OF SOLIDS BY SOLUTIONS AS A FUNCTION OF SOLUTE ADSORPTION. R. J. Ruch and L. S. Bartell (Iowa State Univ. of Science and Tech., Ames). *J. Phys. Chem.* **64**, 513-19(1960) May.

The wetting of flat platinum and chromium slides of small surface area by aqueous solutions of decylamine was measured as a function of the adsorption of the amine and the surface tension of the solutions. Adsorption at the solid-solution interface was measured *in situ* by an optical polarimetric method and wetting was determined concurrently by contact angle measurements employing the captive bubble technique. Adsorption and wetting results for platinum were sharply defined but those for chromium were somewhat obscured by erratic kinetic effects. Multilayer adsorption was observed in all cases, and isotherms on platinum in basic solutions exhibited steps. The observed contact angles of the solutions on platinum rose from 0° to a maximum of about 90° as adsorption increased, and then fell, sometimes to 0° , as adsorption proceeded further. A model is proposed to explain the wetting results which provides a semi-quantitative scheme for computing the behavior of the contact angles from the adsorption isotherms. (auth)

14779

FREE ENERGIES, HEATS AND ENTROPIES OF WETTING OF GRAPHITE. J. J. Chessick, A. C. Zettlemoyer, and Yung-fang Yu (Lehigh Univ., Bethlehem, Penna.). *J. Phys. Chem.* **64**, 530-31(1960) May.

The heats of monolayer formation of toluene, carbon tetrachloride, *n*-heptane, cyclohexane and 1-propanol on graphite were determined by measuring the heats of immersional wetting of the bare and monolayer covered surface. From previously determined free energies of adsorp-

tion, entropies of monolayer formation were calculated. The heats of immersion of the graphite coated with monolayers of toluene, carbon tetrachloride and cyclohexane were considerably below the known surface enthalpies of the corresponding liquids. Even more surprising, the heat of immersion of graphite covered with a monolayer of alcohol was greater than for the immersion of the bare surface. Since for heptane no such unexpected results were obtained, inaccessible area (nitrogen) or reduction by pore filling by the other organic molecules is an unlikely explanation. Furthermore, the results cannot be explained on the basis of customary adsorption thermodynamics. (auth)

14780

THERMODYNAMIC PROPERTIES OF HIGHER FLUORIDES. II. THE HEATS OF SOLUTION AND OF FORMATION OF MOLYBDENUM HEXAFLUORIDE, TUNGSTEN HEXAFLUORIDE AND NIOBIUM PENTAFLUORIDE. O. E. Myers and A. P. Brady (Stanford Research Inst., Menlo Park, Calif.). *J. Phys. Chem.* **64**, 591-4(1960) May.

From solution calorimetry, ΔH_{298}° for $\text{MoF}_6(\text{l})$ was found to be -388.6 kcal/mole and that for $\text{WF}_6(\text{g})$ -416 kcal/mole. No clear cut thermodynamic cycle could be found for NbF_5 , but the average for three approaches giving entirely different end products, and fairly concordant results, was -432 kcal/mole. These data, together with previously obtained entropies, give the free energies of formation of the three compounds. (auth)

14781

ACIDITY MEASUREMENTS WITH THE GLASS ELECTRODE IN H_2O - D_2O MIXTURES. Kirsten Mikkelsen and Sigurd Olaf Nielsen (Carlsberg Lab., Copenhagen). *J. Phys. Chem.* **64**, 632-7(1960) May.

Determinations at 22°C of the thermodynamic dissociation constant of acetic acid in ordinary water and in deuterium-enriched water (98.0 volume % D_2O) demonstrate that an ordinary Radiometer glass electrode type G 202A under convenient experimental conditions exhibits the theoretical response to variations in the hydrogen-ion concentration in both solvents in the range between 2×10^{-2} and 2×10^{-6} M. The acidity determinations involve standardization and storage of the glass electrode in solutions in H_2O and subsequent drying of the glass electrode with mercury before immersing it in the 0.5-ml. deuterium enriched samples. From the electromotive forces observed with a saturated KCl - H_2O calomel electrode at 22°C the relation between true p(DH) and apparent pH in 98% D_2O is derived, $\text{p(DH)} = \text{apparent pH} + 0.44$. A possibility of determining the activities, a_{H} and a_{D} , separately, is considered from the point of view of extrapolating rate data obtained in H_2O - D_2O mixtures to pure D_2O . (auth)

14782

DIFFUSION OF HYDROGEN IN THORIUM. D. T. Peterson and D. G. Westlake (Iowa State Univ. of Science and Tech., Ames). *J. Phys. Chem.* **64**, 649-51(1960) May.

The diffusivity of hydrogen in thorium was measured from 300 to 900°C . Over this temperature range, $D = 2.92 \times 10^{-3} \exp(-9750/\text{RT})$. The diffusivity increased with concentration above 600°C but did not vary significantly with purity, grain size, or cold working. Two different methods of determining diffusion constants were used and gave similar values. (auth)

14783

A SPECTROPHOTOMETRIC STUDY OF THE HYDROLYSIS OF PLUTONIUM(IV). S. W. Rabideau and R. J. Kline (Los Alamos Scientific Lab., N. Mex.). *J. Phys. Chem.* **64**, 680-83(1960) May.

The hydrolysis of Pu(IV) in H_2O and D_2O was studied by

means of spectrophotometric measurements at 3300 Å and various acidities. The data were solved with the least squares method on an IBM computer (704) for the hydrolysis constant $K = [\text{PuOH}^{3+}][\text{H}^+]/[\text{Pu}^{4+}]$. Measurements were made at 15.4 and 25.0°C, and they give 8.5 ± 0.9 and 19.4 ± 1.3 kcal/mole for the heat of hydrolysis in H_2O and D_2O , respectively. For an ionic strength of 2 M and 25.0°C, the weighted K is 0.0185 ± 0.0004 in H_2O and 0.0115 ± 0.0008 in D_2O . This is given a $K_{\text{H}}/K_{\text{D}}$ of 1.6, which is in disagreement with that found from kinetic studies of the $\text{Pu(III)}-\text{Pu(VI)}$ reaction, but in qualitative agreement with the $K_{\text{H}}/K_{\text{D}}$ ratios observed for Np(IV) and U(IV) . The K_{H} is compared with the values derived from earlier spectrophotometric data for Pu(IV) and potentiometric data for the $\text{Pu(III)}-\text{Pu(IV)}$ couple. (D.L.C.)

14784**DESTRUCTION OF DIATOMIC BONDS BY PRESSURE.**

B. J. Alder and R. H. Christian (Univ. of California, Livermore). *Phys. Rev. Letters* 4, 450-2(1960) May 1.

The pressure necessary to destroy the directional character of chemical bonds has been discussed theoretically for hydrogen. This phenomenon has now been experimentally observed in iodine as a first-order phase transition. The delocalization of the electrons causes the diatomic molecular crystal to be converted to a monatomic metal. The experimental results indicate that the transition occurs at 0.7 megabar pressure, 0.53 relative volume, and 1 ev temperature. This does not mean that upon hydrostatic compression iodine would necessarily have the phase transition at those values, since the temperature dependence and the rate of transition of the phase change have to be considered. An empirical rule for the lengthening of diatomic bonds to metallic bonds was used to calculate at what volume iodine should have its transition. The value obtained was 0.53, in agreement with experimental results; an expansion of 15.8% was assumed for the interatomic spacing in iodine. (B.O.G.)

14785

PRODUCTION OF BERYLLIUM FLUORIDE. Alan Raymond Simmonds Gough and Edward William Bennett (to United Kingdom Atomic Energy Authority). British Patent 833,808. Apr. 27, 1960.

A method is given for thermal decomposition of $(\text{NH}_4)_2\text{BeF}_4$ without decomposing NH_4F . A graphite vessel with two graphite electrodes is charged with BeF_2 which is electrically melted. An alternating current (50 cps, 600 amp., 30 v) is then applied as $(\text{NH}_4)_2\text{BeF}_4$ is fed. The temperature should not exceed 950°C. (T.R.H.)

14786

PROCESS FOR THE CONTINUOUS PREPARATION OF TITANIUM AND ZIRCONIUM SUBCHLORIDES, RESPECTIVELY. (to National Distillers and Chemical Corp.). British Patent 834,197. May 4, 1960.

A method is given for preparing Ti and Zr subchlorides by reduction of tetrachlorides with metallic Ti or Zr. In an example, liquid TiCl_4 and sodium are placed in an inert-gas filled reaction vessel in stoichiometric proportions to produce Ti and NaCl. The mixture is heated until the reaction begins, then cooled below 300°C. This reaction produces finely divided Ti-NaCl mixture which is put into a stirred reactor with inert atmosphere and heated to 150°C. Slowly adding TiCl_4 causes a strongly exothermic reaction which oxidizes Ti to TiCl_2 . Upon addition of even more TiCl_4 a product containing 72.5% TiCl_3 and 27.5% NaCl is obtained. (T.R.H.)

Radiation Chemistry and Radiochemistry

14787 NAS-NS-3006

National Research Council. Committee on Nuclear Science.

THE RADIOCHEMISTRY OF AMERICIUM AND CURIUM. R. A. Penneman and T. K. Keenan, Los Alamos Scientific Lab. Jan. 1960. 66p. OTS.

Its Nuclear Science Series.

A review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and a collection of radiochemical procedures for the elements as found in the literature are given. (W.L.H.)

14788 NAS-NS-3008

National Research Council. Committee on Nuclear Science.

THE RADIOCHEMISTRY OF RHODIUM. G. R. Choppin, Florida State Univ. Jan. 1960. 36p. OTS.

Its Nuclear Science Series.

A review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and a collection of radiochemical procedures for the element as found in the literature are given. (W.L.H.)

14789 NAS-NS-3009

National Research Council. Committee on Nuclear Science.

THE RADIOCHEMISTRY OF MOLYBDENUM. E. M. Scadden and N. E. Ballou, Naval Radiological Defense Lab. Jan. 1960. 42p. (OTS)

Its Nuclear Science Series.

A review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and a collection of radiochemical procedures for the elements as found in the literature are given. (W.L.H.)

14790 NAS-NS-3010

National Research Council. Committee on Nuclear Science.

THE RADIOCHEMISTRY OF BARIUM, CALCIUM, AND STRONTIUM. D. N. Sunderman and C. W. Townley, Battelle Memorial Inst. Jan. 1960. 123p. OTS.

Its Nuclear Science Series.

A review of the nuclear and chemical features of particular interest to the radiochemist, a discussion of problems of dissolution of a sample and counting techniques, and a collection of radiochemical procedures for the elements as found in the literature are given. (W.L.H.)

14791 TID-5798

Michigan. Univ., Ann Arbor.

RESONANCE RADIATION EFFECTS OF LOW ENERGY MONOCHROMATIC X-RAYS ON CATALASE. (thesis). Resonance in Radiation Report No. 2. Ardath Henry Emmons. 1959. 122p. Contract AT(11-1)-684. OTS.

The study seeks to determine if a discrete energy x ray is capable of producing damage in excess of that produced at x-ray energies slightly higher and slightly lower. An attempt is made to seek out heretofore unknown responses in catalase to radiation in a limited energy region centered about the k-energy levels of iron. (W.D.M.)

14792 WADD-TR-60-282(Pt.I)

Denver. Univ. Denver Research Inst.

DETERMINATION OF THE RELATIONS BETWEEN STRUCTURE AND RADIATION STABILITY OF ARYL ETHER FLUIDS. [Period] covered: July 15, 1959 to March 1, 1960. Josef J. Schmidt-Collerus and George E. Bohner. Mar. 1960. 42p. Project title: SOLID STATE RESEARCH AND PROPERTIES OF MATTER. Task title: MECHANISMS OF RADIATION EFFECTS ON ORGANIC AND SEMI-ORGANIC MATERIALS. Contract AF33(616)-5317.

The radiolysis of diphenyl ether was found to produce small amounts of gaseous products, mostly hydrogen, and other compounds such as benzene, phenol, *p*-phenylphenol, other phenolic materials, three- and four-phenyl ethers, and rather high molecular weight polymeric material. Radiation produced an increase in the viscosity and index of refraction of the irradiated ethers. The disappearance of irradiated ether molecules is attributed to ether bond cleavage. Postulations are presented for defining a degradation mechanism for the diphenyl ether which can be explained by the observed experimental data. The yield of benzene and phenol from ethers of higher molecular weight than diphenyl ether was considerably less, indicating greater stability to irradiation. Spectral evidence revealed aromatic ring cleavage and some hydrogenation occurred during irradiation. (C.J.G.)

14793

UTILIZATION OF TWO-COMPONENT SYSTEMS IN BUBBLE CHAMBERS. D. V. Neagu and R. G. Salucvadze (Joint Inst. for Nuclear Research, Dubna, USSR). Acad. rep. populare Romîne, Inst. fiz. atomică și Inst. fiz. Studii cercetări fiz. **10**, 733-52(1959). (In Rumanian)

It is shown that, by expansion up to atmospheric pressure, the two-component system with 78% CH₃I and 22% C₃H₈, heated to 74°C, becomes very sensitive to radiations and is a suitable medium for a bubble chamber. The solubility of methyl iodide was investigated. All the systems possible with two or three components, containing in addition to the methyl iodide the compounds CH₄, C₂H₄, CCl₂F₂, CClF₃, C₃H₈, and CO₂, were studied. It was found that with the exception of the CH₃I-C₃H₈ system the existence of the liquid-vapor diphasic system, in the temperature interval from 20 to 90°C and at pressures less than 40 atm., is possible only at low concentrations of the dissolved substance. For the CH₃I-C₃H₈ the existence of the diphasic system is possible at all compositions. The selection of the operational conditions for the biphasic system in a bubble chamber is described. (tr-auth)

14794

C¹⁴ DISTRIBUTION IN IRRADIATION PRODUCTS OF N, N-DIPHENYLBENZAMIDE BY NEUTRONS. Fulvio Cacace and Luciana Cieri (Università, Rome). Ann. chim. (Rome) **49**, 1391-4(1959). (In Italian)

As a consequence of saponification of N,N-diphenylbenzamide irradiated with neutrons, benzoic acid and diphenylamine marked with C¹⁴ are obtained. The radioactivity percentage in acid portion of the molecule is lower if compared to the percentage occurring in diphenylamine, and less than one would expect from the capture cross-sections of recoiling C¹⁴. The C¹⁴ distribution is justified by the different proceeding of reactions which make the primary substitution fragments to become isolable radioactive products. (auth)

14795

STABILIZATION OF THE COLLOIDAL Au¹⁹⁸. Slobod-

danka R. Veljković and Jelica V. Stevović. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade) **10**, 75-86(1960) Mar. (In English)

The effect of gold and gelatine concentration on the stability of Au¹⁹⁸ sols was investigated by the sedimentation method. Results indicate that gold sols behave in accordance with Bishop and Burton's rule. It is shown that organic polycarboxylic acids can in part substitute gelatine as stabilizers, and that the vicinity of COOH groups increases their stabilizing effect. The effect of HNO₃ remnants in preparation procedure was estimated and controlled. (auth)

14796

REDUCTION OF IRON(III) SALTS BY X RADIATION IN THE PRESENCE OF α, α' -DIPYRIDYL. J. Bednář (Militärische Akademie "A. Zápotocký," Czech.). Collection Czechoslov. Chem. Commun. **25**, 1104-12(1960) Apr. (In German)

The effect of oxygen, sulfuric acid concentration, and bromide ion concentration on the reduction of ferric salts with x radiation was investigated in the presence of α, α' -dipyridyl. It was established that concurring reactions of hydrogen atoms with ferric ions and with oxygen on one hand and of hydroxyl radicals with α, α' -dipyridyl and with bromide ions on the other hand occur. At higher pH values, the ferric ions are also reduced by peroxide radicals of α, α' -dipyridyl. (tr-auth)

14797

RADIATION-THERMAL CRACKING OF HYDROCARBONS. A. V. Topchiev, L. S. Polak, N. Ya. Chernyak, V. E. Glushnev, I. V. Verechshinski, and P. Ya. Glazunov (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. **130**, 789-92(1960) Feb. 1. (In Russian)

It is shown that at 400°C the total radiation yield of low molecular hydrocarbon products is ~2000 molecules per 100 ev, ~10³ times the yield at 20°C. Thus, the combined radiation and thermal action produces effective yields for practical application. An installation for radiation-thermal cracking of liquid hydrocarbons is under investigation. (R.V.J.)

14798

E.S.R. SPECTRA AND KINETICS OF THE ACCUMULATION OF RADICALS IN RADIOLYSIS OF CERTAIN AROMATIC COMPOUNDS. I. I. Chkheidze, Yu. N. Molin, N. Ya. Buben, and V. V. Voevodskii (Inst. of Chemical Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. **130**, 1291-3(1960) Feb. 21. (In Russian)

Parametric resonance spectra of radicals produced by 1.6-Mev electrons and the kinetics of their accumulation were investigated in order to determine the properties of radicals formed in the radiolysis of aromatic hydrocarbons. The spectra of benzene, diphenyl, *n*-terphenyl, and *n*-ditolyl were determined at -124 and -33°C. (R.V.J.)

14799

THE RADIATION-INDUCED OXIDATION OF HYDROQUINONES IN AQUEOUS SOLUTIONS. B. H. J. Przybielski-Bielski and R. R. Becker (Columbia Univ., New York). J. Am. Chem. Soc. **82**, 2164-6(1960) May 5.

The oxidation of solutions of hydroquinones in 0.8 N sulfuric acid by Co⁶⁰ gamma rays was studied. The following G values (G = molecules converted/100 ev) in air-saturated solutions were obtained: -G was (2,5-dichloro-*p*-hydroquinone) = 1.42 ± 0.05; -G (2,5-dimethyl-*p*-hydroquinone) = 3.36 ± 0.20; -G (1,2,4-trihydroxybenzene) = 3.12 ± 0.18; -G (2,5-dichloro-3,6-dihydroxy-*p*-hydroquinone) = 7.68 ± 0.53. Mechanisms for these

oxidations based upon these values and those for oxygen consumption, quinone and hydrogen peroxide formation are discussed in terms of the primary decomposition products of water radiolysis. (auth)

14800

THE FREE RADICALS FORMED BY THE ACTION OF γ -RAYS ON SOLID GLYCINE. D. K. Ghosh and D. H. Whiffen (Massachusetts Inst. of Tech., Cambridge). *J. Chem. Soc.* 1969-73(1960) Apr.

Electron resonance spectra of γ -irradiated glycine and its deuterated derivatives are presented and their subsequent changes with time and heating are followed. $\dot{\text{N}}\text{H}_2$ appears to be the dominant radical product and there is evidence for at least one unidentified radical as well as the radical $^+\text{H}_3\text{N} - \dot{\text{C}}\text{H} - \text{CO}_2^-$ postulated in an earlier publication. (auth)

14801

RADIOLYSIS OF ORGANIC LIQUIDS CONTAINING DISSOLVED ION. Gordon Hughes and Warren M. Garrison (Univ. of California, Berkeley). *J. Phys. Chem.* 64, 695-6 (1960) May.

The production of iodine (I_2) and organic iodides (RI) upon irradiation of solutions of ICN in methanol and cyclohexane by gamma rays was studied by spectrophotometric determination of I_2 and, in the case of RI, by determination of the I^{131} retention by the solvent after extraction of excess I^{131}CN . The I_2 concentration in methanol is plotted vs. irradiation time; the initial rate of I_2 production is independent of ICN concentration and corresponds to $G(\text{I}_2) = 3.4$. Production of I_2 in methanol is attributed to reduction of ICN by H and/or CH_2OH radicals, which results in a radical yield of 6.8, in good agreement with the values obtained for methanol with ferric ion scavengers. For cyclohexane, $G(\text{RI})$ is plotted vs. ICN concentration; the curve does not approach a limit for $G(\text{RI})$. No production of I_2 was observed. Production of RI in cyclohexane is attributed to the reaction of alkyl radicals with I atoms produced by $\text{H} + \text{ICN} \rightarrow \text{HCN} + \text{I}$ (D.L.C.)

14802

THE KINETICS AND MECHANISM OF THE SOLID STATE POLYMERIZATION OF ACRYLAMIDE. H. Morawetz and T. A. Fadner (Polytechnic Inst., Brooklyn). *Makromol. Chem.* 34, 162-9(1959). (In English)

Crystalline acrylamide exposed to γ rays polymerizes after removal from the irradiation source for periods of many months. The molecular weight of the product increases by about the same factor as the polymer yield. At 25°C , the initial propagation rate coefficient is 2.6×10^6 times lower than in water solution. The kinetics of the reaction are consistent with bimolecular radical termination and intermediate between those expected for a uniform radical distribution and the radical growth in isolated "tracks" of the γ rays, but electron spin resonance measurements indicate little decay of the radical concentration with time. In solid solutions of acrylamide and propionamide, which is isomorphous with the monomer, the polymer chain length is determined by chain transfer to propionamide. The high chain transfer efficiency of propionamide in solid solution is indicative of the restraints imposed on the direction of the chain growth by lattice forces. There is no appreciable chain transfer in solid solutions of acrylamide containing the non-isomorphous acetamide as the second component. (auth)

14803

SIGNIFICANCE OF THE 'EQUIVALENT REDOX POTENTIAL' IN AQUEOUS SOLUTIONS UNDER IONIZING RADI-

ATION. G. H. Cartledge (Oak Ridge National Lab., Tenn.). *Nature* 186, 370-2(1960) Apr. 30.

An evaluation is presented of the significance of the equivalent redox potential in aqueous solutions under ionizing radiation. The discussion is limited to steady states. (C.H.)

14804

POLYMER FORMATION IN IRRADIATED p-XYLENE. Francis van Hecke (Conseil en Génie Chimique, Brussels). *Nature* 186, 382-3(1960) Apr. 30.

The kinetics of radiolysis was studied in p-xylene, biphenyl, and mixtures of the two under mixed atomic pile irradiation. Typical experimental results are summarized in tabular form. Results indicate that p-xylene polymerizes according to the same rate law as biphenyl, which means the reaction is a first-order process. (C.H.)

14805

MODES OF RADIATION-INDUCED CROSS-LINKING IN HYDROCARBON POLYMERS. T. F. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Nature* 186, 544-5(1960) May 14.

Reaction mechanisms involved in radioinduced cross-linking of hydrocarbon polymers are discussed. Evidence is cited on reactions in irradiated polypropylene. (C.H.)

14806

THE EFFECTS OF HIGH DOSE RATES OF IONIZING RADIATIONS ON SOLUTIONS OF IRON AND CERIUM SALTS. J. Rotblat and H. C. Sutton (St. Bartholomew's Hospital Medical Coll., London). *Proc. Roy. Soc. (London)* A255, 490-508(1960) May 10.

The electron beam generated by a 15 Mev linear accelerator was employed to induce reactions in aerated aqueous solutions of 1 to 25 mM ferrous sulfate, and of 0.1 to 1 mM ceric sulfate. The radiation was delivered in pulses of 1.3 μs duration and over a range of dose rates from 0.5 to 20,000 rads/pulse. Radiation yields at constant dose rate were compared with the aid of a chemical dose monitor. A system of two thin, widely spaced, irradiation vessels was employed to determine the variation of yield of any one system over successive known ranges of dose rate. The yield of ferric sulfate in the iron system was found to decrease with increasing dose rate in the range 0.01 to 10 krad/pulse by an over-all factor of 0.85, and was appreciably dependent on the initial concentrations of dissolved oxygen and of ferrous sulfate at high dose rates. Yields of hydrogen and of hydrogen peroxide were practically independent of dose rate. The observations are interpreted on the basis of inter-radical reactions which occur when the reaction zones of neighboring clusters overlap. The following reactions can account for all the data: (1) $\text{OH} + \text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{OH}^-$, (2) $\text{H} + \text{O}_2 \rightarrow \text{HO}_2$, and (3) $\text{H} + \text{OH} \rightarrow \text{H}_2\text{O}$. The values $k_1/k_3 = 0.0062$ and $k_2/k_3 = 0.22$ are reasonably consistent with the observations. In the ceric sulfate system the yield of cerous sulfate increases progressively over the range 0.01 to 10 krad/pulse by an over-all factor of 1.4. The data accord with the view that at high dose rates OH radicals react with themselves ultimately to form hydrogen peroxide, in competition with their normal reaction with cerous sulfate. (auth)

14807

THE RADIOLYSIS AND RADIATION OXIDATION OF DIISOPROPYL ETHER. V. V. Saraeva, B. Ya. Ladygin, and Nam Chan Sun (Lomonosov Moscow State Univ.). *Zhur. Fiz. Khim.* 34, 759-61(1960) Apr. (In Russian)

The formation of carbonyl compounds and alcohols during the x radiation of diisopropyl ether in the absence of

oxygen was investigated. The initial yield of carbonyl compounds was found to depend to a great extent upon the presence of impurities in the ether. On irradiation of the ether in the presence of oxygen the yield of carbonyl compounds and alcohols greatly increased and peroxides and acids appeared. It is suggested that conversion of the ether takes place by a chain mechanism both in the presence and absence of oxygen. (auth)

14800

RADIOCHEMICAL CONVERSION OF LIGHT ALIPHATIC HYDROCARBONS. (to Esso Research and Engineering Co.). British Patent 834,323. May 4, 1960.

A radiochemical process is described in which C_1 to C_6 hydrocarbons are converted to higher paraffins and olefins. Addition of an inert polyatomic gas before irradiation increases the yield considerably. In an example, a 50-50 mol % CH_4-N_2 mixture was exposed to a 2900-curie Co^{60} source at 10^6 r/hr at $110^\circ F$ and 900 psig. When 321 BTHUs/lb of radiation had been absorbed, it was found that 7.3 molecules of CH_4 had reacted per ion pair, compared to 2.8 for a pure CH_4 experiment. (T.R.H.)

Raw Materials and Feed Materials

14809 MCW-1386

Mallinckrodt Chemical Works, St. Louis.

SLAG RESIDUE PLANT DESIGN CRITERIA. Feb. 29, 1956. Decl. Mar. 31, 1960. 61p. OTS.

The design criteria are presented for a slag processing plant for the purpose of processing U-Mg fluoride slag, generated in the thermite reduction of UF_4 by Mg to U metal. (W.L.H.)

14810 MCW-1399

Mallinckrodt Chemical Works, St. Louis.

PROCESS DEVELOPMENT QUARTERLY REPORT. PART I. LABORATORY WORK. Nona Kuhlman, ed. Jan. 1, 1957. Decl. Mar. 31, 1960. 151p. Contract W-14-108-eng-8. OTS.

The evaluation of current feed materials for insoluble and unextractable U was made. A fluoride volatilization process has been proposed for the preparation of UF_6 from ore concentrates. Work on the reactivity test for UO_3 has continued. The variables which govern the rate of hydrofluorination of 3 to 5 mm deep powder beds of various UO_2 samples are being investigated thermogravimetrically. An investigation of H_2 in derby metal is presented. Halide corrosion of Weldon Spring nitric acid recovery system is discussed. A titrimetric method for the determination of H_2 present as water and HF in UF_4 is presented. A procedure for rapid estimation of NO_3^- in UO_3 is presented. A method for the determination of ethyl ether-soluble organic matter in U concentrates is presented. (W.L.H.)

14811 NP-8639

Canada. Dept. of Mines and Technical Surveys. Mines Branch.

CONTINUOUS MONITORING OF URANIUM LEACH SOLUTIONS. G. G. Eichholz. Jan. 21, 1960. 27p.

Available as Can. Dept. Mines and Tech. Surveys, Mines Branch Research Rept. R 59. \$0.25.

A method for determination of uranium content in leach solutions by alpha particle scintillation reactions with plastic phosphors is described. The method appears to be applicable to continuous monitoring and control of breakthrough in ion exchange columns. (J.R.D.)

14812

IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF ENRICHED URANIUM AND COMPOUNDS

TION OF ENRICHED URANIUM AND COMPOUNDS

THEREOF. Keith David Bebb Johnson and Ralph Eric Worthington (to United Kingdom Atomic Energy Authority). British Patent 833,982. May 4, 1960.

A method is given for converting enriched UF_6 to metal or for blending with U of lower enrichment. In an example UF_6 is placed in a Ni vessel, heated to $150^\circ C$ and UF_6 admitted to yield, after 200 minutes, enriched UF_6 . (T.R.H.)

14813

APPARATUS FOR THE PRODUCTION OF URANIUM FLUORIDE. (to Commissariat à l'Énergie Atomique).

German Patent DAS 1 051 830. Mar. 5, 1959. *Kerntechnik* 2, 148(1960) Apr. (In German)

The apparatus for the production of uranium fluoride by decomposition of powdered uranium oxide with gaseous hydrofluoric acid works at a temperature between 500 and $600^\circ C$. The characteristics of the apparatus are sketched. It consists of a perpendicular cylindrical chamber with a series of trays arranged on top of each other. The trays are provided with orifices and a device is used to agitate these trays constantly during the process. The hydrofluoric acid is let in at the bottom of the apparatus and the uranium oxide enters from the top. Heating elements coiled around the tube provide the heating. (J.S.R.)

Separation Processes

14814 CF-60-1-124

Oak Ridge National Lab., Tenn.

PROPOSED HYDROGEN SAFETY AND DISPOSAL PROCEDURES FOR THE PRFR PILOT PLANT. J. M. Holmes, A. R. Irvine, and J. P. Nichols. Jan. 20, 1960. 10p. OTS.

Explosion and detonation hazards from hydrogen-air mixtures are reviewed and safety measures for hydrogen handling are recommended. Three hydrogen disposal procedures are proposed for the Power Reactor Fuels Re-processing pilot plant which will employ the Sulfex process. (auth)

14815 NAA-SR-4942

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

SEPARATION OF URANIUM FROM THORIUM BY LIQUID METAL EXTRACTION. Interim Report. F. W. Dodge, J. D. Chilton, and L. A. Hanson. May 1, 1960. 24p. Contract AT(11-1)-GEN-8. OTS.

A method of separating bred uranium from thorium blanket fuel by liquid metal extraction is under investigation. Experimental work to date on the thorium-uranium-magnesium system shows promise, and continued investigation is warranted. On dissolution of natural thorium-uranium fuel in molten magnesium over 95% of the uranium introduced has been recovered as a uranium-thorium-magnesium concentrate. Satisfactory metallic buttons or castings essentially free of magnesium have been made from these uranium concentrates by either arc melting or induction heating after preliminary evaporation of the bulk of the magnesium. The lowest Th/U ratio obtained to date is about 1/1, compared to 10/1 in the original alloy. Type 300 series stainless steels have been found reasonably satisfactory for container vessels and piping, but there has been some evidence of contamination of the melts with iron and traces of nickel and chromium. (auth)

14816 NP-8663

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

SEPARATION OF SOME RARE EARTHS BY REVERSED-

PHASE PARTITION CHROMATOGRAPHY. (Rozdzielenie Niekłótych Ziemi Rzadkich za Pomocą Chromatografii Podziałowej z Odwróconymi Fazami). Report No. 129/V. S. Siekierski and I. Fidelis. Jan. 1960. 10p.

The reversed phase partition chromatography was applied to the separation of small amounts of some rare earths. As a stationary phase TBP was used, and the elution was carried out with concentrated HNO_3 . (auth)

14817 NP-8664

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

EXTRACTION FROM SOLUTIONS OF PERCHLORIC ACID BY TRIBUTYLPHOSPHATE. I. PARTITION COEFFICIENTS FOR ZIRCONIUM, THORIUM, CERIUM, PROMETHIUM AND YTTRIUM. (Ekstrakcja z Roztworów Kwasu Nadchlorowego za Pomocą Trójbutylofosforanu. I. Współczynniki Podziału dla Cyrkonu, Toru, Ceru, Prometu i Itru). Report No. 130/V. S. Siekierski. Jan. 1960. 13p.

Zirconium, thorium, cerium, promethium, and yttrium are well extracted by TBP from concentrated solutions of perchloric acid. Partition coefficients increase steadily with increasing acid concentration, except at low acidities. Thorium is better extracted than zirconium and the ratio of partition coefficients is constant at all acidities. Cerium and promethium have the same partition coefficient, and the coefficient for yttrium is somewhat smaller. (auth)

14818 Pub/UP/R-20

Israel. Atomic Energy Commission, Tel Aviv.

ANION EXCHANGE OF LANTHANIDES AND ACTINIDES IN INORGANIC MEDIA. Y. Marcus. [1959?]. 9p.

Volume distribution coefficients of lanthanide elements between nitrate solutions, thiosulfate solutions, and acetone and an anion exchanger were measured. Elution curves are presented for the separation of lanthanides on an exchange column at 78°F using lithium nitrate and for the separation of actinides at 68°F using hydrochloric acid. Volume distribution coefficients of actinides were determined between hydrochloric acid and an anion exchanger. (C.J.G.)

14819 JPRS-2509

THE EFFECT OF THE NATURE OF THE SALTING-OUT AGENT ON THE DISTRIBUTION OF SMALL QUANTITIES OF URANYL NITRATE BETWEEN AQUEOUS SOLUTION AND DIETHYL ETHER. V. M. Vdovenko and T. V. Kovaleva. Translated from *Zhur. Neorg. Khim.* 2, 1682-6 (1957). 10p. OTS.

A comparison was made of the salting-out effectiveness of nitrates of Li, Na, NH_4K , Mg, Ca, BaSr, Zn, Cd, Al, and Fe on $\text{UO}_2(\text{NO}_3)_2$ distributed in aqueous $(\text{C}_2\text{H}_5)_2\text{O}$ at 0, 15, and 25°C. These nitrates are sparingly soluble in $(\text{C}_2\text{H}_5)_2$. The results show that with constant salt concentration the distribution coefficient of $\text{UO}_2(\text{NO}_3)_2$ decreases as temperature increases. At equal mole fractions of salt the salting-out action increases with increasing charge and with decreasing cation radius. (T.R.H.)

14820 JPRS-2514

ON THE DISTRIBUTION OF NITRIC ACID AND URANYL NITRATE BETWEEN AN AQUEOUS SOLUTION AND DIBUTYL ETHER. V. M. Vdovenko, A. A. Lipovskii (Lipovskiy), and M. G. Kuzina. Translated from *Zhur. Neorg. Khim.* 2, 975-9 (1957). 9p. OTS.

The distribution of $\text{UO}_2(\text{NO}_3)_2$ and $\text{UO}_2(\text{NO}_3)_3$ in aqueous dibutyl ether was investigated in relation to HNO_3 concentration. The results are presented graphically. It is indicated that the considerable solubility of HNO_3 in this ether may be explained by the formation of oxonium compounds. An increase in HNO_3 concentration increases the concen-

tration of the complex trinitroureanyl ion in dibutyl ether. The decrease in the distribution factor of UO_2^{2+} at very high HNO_3 concentrations in the aqueous phase might be connected with a competition between the distributable substances. (T.R.H.)

14821

EFFECT OF TEMPERATURE AND LENGTH OF HEATING ON THE SELECTIVE PROPERTY OF ZIRCONIUM PHOSPHATE USED AS EXCHANGER. Giulio Alberti and Arminio Conte (Comitato Nazionale per le Ricerche Nucleari, Rome). *Atti accad. naz. Lincei. Rend. Classe sci. fis. mat. e nat.* (8) 27, 224-9 (1959) Nov. (In Italian)

The heating of zirconium phosphate modifies the selective properties of such exchangers. Such modifications persist even after successive regenerations of the exchanger. By heating to a moderate temperature, it is possible to obtain samples of zirconium phosphate with which one can effect separations better, even with concentrated solutions, than is possible with non-treated zirconium phosphate. By treatment at high temperature the exchange capacity is strongly decreased. Application to the separations of mixtures at high dilutions remains possible, however. (tr-auth)

14822

SEPARATION OF CARRIER-FREE P^{32} FROM ELEMENTARY SULPHUR ON A SILICA GEL COLUMN. Olga Ž. Javanović-Kovačević. *Bull. Inst. Nuclear Sci. "Boris Kidrič" (Belgrade)* 10, 51-9 (1960) Mar. (In English)

A simple and rapid separation of P^{32} from elementary sulfur on a silica gel column is described. Fluor of sulfur is converted into the α form before irradiation, so that the irradiated material becomes completely soluble in CS_2 . After irradiation, the sulfur is dissolved in CS_2 and passed through the column, where P^{32} is absorbed. Optimal conditions for the separation are given. (auth)

14823

CONCENTRATION OF CARRIER FREE P-32 BY ADSORPTION ON ALUMINA. Slobodanka R. Veljković and Slavko M. Milenković. *Bull. Inst. Nuclear Sci. "Boris Kidrič" (Belgrade)* 10, 61-9 (1960) Mar. (In English)

Conditions for optimum separation of phosphates from other salts with an alumina column are determined. Most salts are without effect at concentrations up to 2 N. Extremely small concentrations of phosphates in the form of carrier-free P^{32} could be separated from various mixtures by adsorption on alumina with an efficiency of about 95%. Elution of adsorbed phosphates by alkalis (2.5 N NaOH) is greatly facilitated by H_2O_2 oxidation during adsorption. The same efficiency of adsorption and elution was obtained with P^{32} produced in a sulfate by neutron bombardment. The method seems to be convenient for use in the production of P^{32} from sulfates having undergone the $\text{S}^{32}(\text{n,p}) \text{P}^{32}$ reaction. (auth)

14824

SEPARATION OF P-32 FROM S-35 AND FROM SOME OTHER ANIONS ON MgO . Slobodanka R. Veljković and Slavko M. Milenković. *Bull. Inst. Nuclear Sci. "Boris Kidrič" (Belgrade)* 10, 71-4 (1960) Mar. (In English)

The selective adsorption of carrier-free quantities of P^{32} on MgO from dilute solutions of various salts was studied. A few tens of milligrams of the adsorbent accomplished the quantitative separation of P^{32} and S^{35} . Sulfates at concentrations higher than 0.5 N affected adsorption. Working conditions, necessary for adsorption yields higher than 80% from mixtures with sulfates were studied. A possible use in production of P^{32} and S^{35} is suggested. (auth)

14825

THE RELATIVE EFFECTS OF THE URANYL SULFATE COMPLEXES ON THE RATE OF EXTRACTION OF URANIUM FROM ACIDIC AQUEOUS SULFATE SOLUTIONS. Kenneth A. Allen (Oak Ridge National Lab., Tenn.). *J. Phys. Chem.* **64**, 667-70 (1960) May.

At constant sulfuric acid activity, constant low total uranium concentration and constant extractant concentration, the rate of extraction of uranyl sulfate by tri-*n*-octylamine sulfate in benzene decreases with increasing aqueous sulfate ion activity as a linear function of the corresponding decrease in the fraction of the aqueous uranium present as the dipositive uranyl ion. On the basis of the reasonable hypothesis that the first-order behavior of the system as a whole extends to the species UO_2^{2+} , UO_2SO_4 , and $\text{UO}_2(\text{SO}_4)_2^{2-}$, it is shown that the data permit estimation of the individual rate constants for these species. The ratios of these constants to each other, in turn, indicate that UO_2^{2+} is about six times as effective as either UO_2SO_4 or $\text{UO}_2(\text{SO}_4)_2^{2-}$ in transferring uranium from such aqueous systems to an extracting phase. (auth)

14826

AN EXTRACTABLE COMPLEX OF DIBUTYL PHOSPHATE AND PHOSPHORIC ACID. B. J. Thamer (Los Alamos Scientific Lab., N. Mex.). *J. Phys. Chem.* **64**, 694-5 (1960) May.

The partition of dibutyl phosphate (DBP) between an aqueous phase consisting of 0 to 3.76 *M* H_3PO_4 , 0.510 *M* H^+ , and 1.07 *M* ionic strength (HClO_4 and NaClO_4 added) and the organic phase, kerosene, was studied. A log-log plot of DBP concentration in the organic phase vs. that in the aqueous phase gave straight lines of slope 2 up to a certain point, above which the slope increased, indicating the existence of polymers higher than two in the organic phase. Addition of H_3PO_4 to the aqueous phase increased the DBP partition in the organic phase. The reactions are postulated to be (1) $2 \text{DBP}(\text{aq}) = (\text{DBP})_2(\text{org})$ and (2) $(\text{DBP})_2(\text{org}) + x \text{H}_3\text{PO}_4(\text{aq}) = (2 \text{DBP} \cdot x \text{H}_3\text{PO}_4)(\text{org})$. The data gave a distribution constant of $325 \pm 12 \text{ M}^{-1}$ for reaction (1) and a formation constant of 0.31 ± 0.03 for reaction (2), with $x = 1.8 \pm 0.1$. (D.L.C.)

14827

SEPARATION AND DETERMINATION OF URANIUM AND THORIUM WITH 3-ACETYL-4-HYDROXYCOUMARIN. A. N. Bhat and B. D. Jain (Univ. of Delhi). *Talanta* **4**, 13-16 (1960) Mar. (In English)

The separation of uranium from thorium, and the determination of these elements, even in the presence of more than ten times the amount of cerium^{III} and lanthanum, can be readily accomplished by using 3-acetyl-4-hydroxycoumarin as complexing agent, because of the marked differences in the solubilities in ethanol of the complexes. (auth)

14828

THE SEPARATION AND IDENTIFICATION OF MANGANESE, TECHNETIUM, RHENIUM, RUTHENIUM AND MOLYBDENUM ON THE ULTRAMICROSCALE. Fadhil Jasim, Robert J. Magee, and Cecil L. Wilson (Queen's Univ., Belfast). *Talanta* **4**, 17-24 (1960) Mar. (In English)

A scheme is presented for the separation and detection of manganese, technetium, rhenium, ruthenium, and molybdenum on the ultramicroscale. A number of confirmatory tests for these elements on this scale have been investigated and the results are reported. A survey of reagents suitable for the approximate estimation of technetium, rhenium, and molybdenum has been carried out and these

are combined in a separation scheme for these elements. (auth)

14629

RECOVERY OF PLUTONIUM AND ALUMINUM FROM PLUTONIUM-ALUMINUM ALLOYS. (to Atomic Energy of Canada, Ltd.). British Patent 833,720. Apr. 27, 1960.

A method is given for separating Pu from Al with removal of the Al as waste. The alloy is heated in vacuum to 1200 to 1450°C to vaporize Al. The Pu residue contains some Al and fission products, but can be re-alloyed and returned to the reactor. (T.R.H.)

14630

SOLVENT-EXTRACTION OF U^{233} FROM NEUTRON-IRRADIATED THORIUM. (to United Kingdom Atomic Energy Authority). British Patent 833,981. May 4, 1960.

A solvent extraction process is described for separating U^{233} from neutron-irradiated Th. A HNO_3 solution of the Th is made and contacted with methylisobutyl ketone. For separation from Pu an acidity adjustment and salting-out agent are used. (T.R.H.)

14831

PROCESS OF TREATING TITANIUM, ZIRCONIUM OR HAFNIUM AND THEIR ALLOYS. (to Carborundum Co.). British Patent 834,148. May 4, 1960.

A process is given for dissolving Ti, Zr, or Hf and their alloys in NH_4F for recovery without increased hardness. The metal is immersed in aqueous NH_4HF with a pH of 6 or 7 and dissolves with evolution of NH_3 and H_2 . The optimum conditions are shown by various dissolution data tabulations. In an example, a batch of degreased Zircaloy-2 lathe turnings was found to have an increased hardness when recovered by an arc-melting process. When dissolved in 30% NH_4F until 6% weight loss occurs, then washed in 5% HNO_3 , water-washed, and acetone-dried, the resulting scrap when arc-melted had a slightly lower hardness than the scrap material started with. (T.R.H.)

14832

PROCESS FOR THE SEPARATION OF THE ELEMENTS ZIRCONIUM AND HAFNIUM. (to Deutsche Gold-und Silber-Scheideanstalt vormals Roessler). British Patent 834,271. May 4, 1960.

A process is given for separation of Th and Zr involving partition of their thiocyanates. In an example, a tetrachloride mixture containing 0.8% HfO_2 was dissolved in water and the solution was saturated with NH_4SCN at 20°C. This solution was shaken with half its volume of diethyl ether 1.5*N* in HSCN . Analysis of the two phases showed $k(\text{Hf}) = 18.9$, $k(\text{Zr}) = 3.5$, $\beta = 5.4$. A similar experiment in which anhydrous $\text{ZrCl}_4\text{-HfCl}_4$ was slowly dissolved in saturated NH_4SCN solution gave $k(\text{Hf}) = 16.5$, $k(\text{Zr}) = 1.6$, $\beta = 10$. Other examples are given. (T.R.H.)

14932

URANIUM RECOVERY PROCESS. James Harold Yeager. (to U. S. Atomic Energy Commission). British Patent 834,360. May 4, 1960.

A solvent extraction process is described which recovers U from acid leach solutions without a leach-filtration process. In an example an aqueous feed slurry containing 225 g/l of U was extracted three times with a 30% TBP-70% naphtha mixture at 2500°C. For three runs recoveries of 99.8%, 99.9%, and 97.9% were obtained. (T.R.H.)

14834

IMPROVEMENTS IN URANIUM RECOVERY. (to United Kingdom Atomic Energy Authority). British Patent 835,690. May 25, 1960.

Uranium complexed with diethyldithiocarbamate can be

extracted into methylisobutyl ketone and separated from Th and Pa. A method is given for recovery of U from this organic solution which involves treatment with 10% $(\text{NH}_4)_2\text{CO}_3$ solution. (T.R.H.)

14835

IMPROVEMENTS IN OR RELATING TO LIQUID-LIQUID CONTACTING APPARATUS. Leonard Lowes and Maurice Charles Tanner (to United Kingdom Atomic Energy Authority). British Patent 835,912. May 25, 1960.

An in-line mixer-settler arrangement is described which lessens criticality considerations in handling fissile material. Mixer and settler compartments alternate in a straight trough with transverse partitions. Longitudinal partitions allow flow between stages. (T.R.H.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

14836 CF-60-3-103

Oak Ridge National Lab., Tenn.

THE APPLICABILITY OF PACKED GLASS RASCHIG RINGS FOR NUCLEAR SAFETY IN LARGE VESSELS. J. P. Nichols. Mar. 24, 1960. 13p. OTS.

Simple calculations indicate that large diameter vessels packed with boron-containing glass Raschig rings are applicable for storage of high concentration solutions of fissile material. Use of this means for storage of fissile solutions can result in appreciable savings. Advantages and disadvantages are discussed and tests are enumerated that must be made to confirm the applicability of glass Raschig rings as a fixed poison. (auth)

14837 KY-326

Union Carbide Nuclear Co. Paducah Plant, Ky. FABRICATION OF THE TYPE "E" FLUORINE CELL TANK. B. W. Clark. May 5, 1960. 23p. Contract W-7405-eng-26. OTS.

The design and fabrication techniques utilized in the construction of an improved 6000 ampere fluorine cell tank which is expected to increase the service life of the tank by a margin of greater than two to one are described. A savings in labor and material made possible through the use of the improved fabrication techniques is noted. (auth)

14838 NYO-2899

Westinghouse Electric Corp. Research Labs., Pittsburgh. ULTRAHIGH VACUUM TECHNIQUES. Quarterly Progress Report for Period Covered January 1-March 31, 1960. Research Report 403FF530-R1. Apr. 25, 1960. 13p. Contract AT(30-1)-2176. OTS.

The evaluation of zeolite traps and other vacuum components was continued. The effectiveness of zeolite for isolation of vacuum systems over long periods of time was demonstrated. Some preliminary results on the welding characteristics of a new stainless steel appear to be promising. Data which further describe the alloy are not included. Development of a photomultiplier ion gage which is capable of measuring pressures of 10^{-10} mm Hg without a hot filament is reported. Preliminary results with an ion beam tube indicate that this type of apparatus offers a more satisfactory method for studying ionic reactions with surfaces. (For preceding period see NYO-2897.) (J.R.D.)

14839

PLAN OF HOT CELLS. [PART] I. Thomas Jaeger. *Kerntechnik* 2, 113-20(1960) Apr. (In German)

Hot cells in which gamma-radiating material in the curie

or megacurie range is handled are discussed. The problem complex which the engineer must oversee includes radiation shielding, surface development, remote-control equipment, shielded observation, good ventilation, and safe removal of radioactive waste material in any form. (tr-auth)

14840

WALLS FOR ULTRAHIGH VACUUM CONTAINMENT FROM MOLDED LAMINATES. H. L. Eschbach and R. Jaeckel (Universität, Bonn). *Z. Naturforsch.* 15a, 268-9(1960) Mar. (In German)

In ultrahigh vacuum investigations, a series of problems exist which play either no role or a very insignificant one in high vacuum studies. The internal wall of the vacuum chamber must be tested for its suitability. The principal problems are solubility of gases in the wall, desorption processes during the heating and under ion impact, and gas penetration of the wall. The faults of glass and metal chambers in these respects are discussed. A vacuum chamber constructed of an enamelled iron membrane was described. With such a membrane no diffusion of hydrogen could be detected. Heating temperatures of 450°C were tolerated. (J.S.R.)

Heat Transfer and Fluid Flow

14841 GEAP-3215

General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.

HYDRAULIC INSTABILITY IN A NATURAL CIRCULATION LOOP WITH NET STEAM GENERATION AT 1000 PSIA. S. Levy and E. S. Beckjord. July 15, 1959. 47p. Contract AT(04-3)-189. OTS.

The performance of a natural circulation loop was studied at 1000 psia. Tests were performed with rods heated electrically inside a pipe. Test results reveal that flow instability occurs at lower steam qualities and higher flows as the inlet subcooling is increased. Oscillatory conditions were obtained for calculated exit void fractions ranging from 0.6 to 0.9. Data are included on several instability conditions for fixed systems at given pressures, and their variations with heater and system geometry. (J.R.D.)

14842

PERIODICAL MOTIONS OF A VISCOUS INCOMPRESSIBLE FLUID. V. I. Yudovich (Rostov-on-Don State Univ., USSR). *Doklady Akad. Nauk S.S.S.R.* 130, 1214-17(1960) Feb. 21. (In Russian)

The theorem of the occurrence of "an integer" in solutions for non-linear ordinary differential equations in Gilbert space was substantiated. The derived results are applied to periodic motion of an incompressible liquid. (R.V.J.)

14843

PUMPING STUDIES ON AQUEOUS THORIA SLURRIES. R. Murdock and H. A. Kearsey (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Fluid Handling* No. 122, 63-6(1960) Mar.

Viscometer and loop experiments were conducted on aqueous thoria slurries in order to study their rheological characteristics. The viscometer data, obtained in a pipeline viscometer, indicate that such slurries fit the Crowley and Kitzes (Robinson) equation relating the observed viscosity to that of the medium. The loop data were compared with the viscometer measurements; the horizontal pipe data agreed well with the viscometer data for flows above that corresponding to the development of inhomogeneity,

but did not agree for flows less than that. Vertical pipe experiments were made and found to agree, and it is concluded that settling occurs in horizontal pipes for low flows. The mean linear velocity at which turbulence occurs remains roughly constant. The equipment for the measurements and metriflow (injection of substances into a flow) is described. (D.L.C.)

14844

ON THE CONVECTIVE HEAT TRANSFER FOR TURBULENT FLOW OF SINGLE-PHASE FLUID THROUGH CONCENTRIC ANNULI. Pu-hsuan Wang (Tsing-hua Univ.). *Sci. Sinica (Peking)* 8, 98-109(1959) Jan. (In English)

Preliminary experimental data on the heat transfer coefficient at the inner wall for turbulent flow of water through concentric annuli with $d_2/d_1 = 1.84$ (d_1 and d_2 being the diameters of the inner and outer wall respectively), deviate from W. H. McAdams' and M. A. Mikheyev's recommended formulas, yet agree with E. S. Davis' equation. A general survey is given on the knowledge of turbulent flow heat transfer of single-phase fluids through concentric annuli. It is concluded that, although numerous investigations of forced convective heat transfer in concentric annuli have been reported, appreciable inconsistencies in the data make the known correlations for the heat transfer coefficient at the inner wall uncertain. (auth)

14845

HEAT TRANSFER AND THERMAL STRESS IN FINNED TUBES. *VDI Zeitschrift* 102, 423(1960) Apr. 11. (In German)

Practical data for the transfer of heat flow were produced in a generally acceptable form on the basis of extensive theoretical and experimental investigations into the individual processes involved in heat transfer in finned tubes. The resulting theory also supplies, in addition to the heat transfer formulas containing convection coefficients, the complete temperature field pattern in the tube wall and in the fins. From this the thermal stresses under a transient-free condition or during heating can be calculated. (tr-auth)

14846

IMPROVEMENTS IN AND RELATING TO STEAM CONDENSER INSTALLATIONS FOR STEAM TURBINE POWER PLANT. (to Hick, Hargreaves and Co., Ltd.). British Patent 835,419. May 18, 1960.

A steam condenser arrangement for turbine power plants which have excess steam at times is described. A dump condenser with cooling water connections in parallel with steam turbine condensers receives surplus steam. Cooling water from the turbine condensers is mixed with coolant from the dump condenser so that a predetermined maximum temperature is not exceeded. The quantity of cooling water passing through the dump condenser is a proportion of the total circulating water requirements of the condenser installation, and the pressure drop across it is less than that across the main condensers. (T.R.H.)

Instrumentation

14847 AD-230930

Centre de Physique Electronique et Corpusculaire, Orsay, France.

DESIGN AND DEVELOPMENT OF 4 MILLIMETER PROTOTYPE CARCINOTRON TUBES WITH MAGNETS. Final Report, July 1959. 103p. Contract AF61(514)-919. (WR-411)

A summary is presented of the studies which were made to test the power production capabilities of the Carcinotron principle in the 4 mm wavelength range. A short survey of the theory of operation of the tube in the mm range is made, and the main design features for the watt level are examined. The results of the study on the gun and slow wave structure are reported. The technology of the tube is described and the operating characteristics of different experimental tubes are given. (W.D.M.)

14848 AFSWC-TN-59-27

Air Force Special Weapons Center, Kirtland AFB, N. Mex. RESULTS OF TESTING THE RADIACMETER MODEL PAC-1S. William C. Bryan. Oct. 1959. 44p. Project No. 7806.

Events leading to standardization of the Radiacmeter, Alpha Scintillation Counter PAC-1S for Air Force use are summarized, and a description of the instrument is given. Various tests to which the PAC-1S and the type BC-1 battery charger were subjected are described, along with their results. These tests included visual and mechanical inspection, electrical measurements, radiation tests, environmental and mechanical tests, field tests, and some observations of the charge-discharge behavior of the PAC-1S zinc-silver oxide batteries. In general the instruments were found satisfactory for Air Force use with the provision that certain minor changes in design be made and certain quality control procedures be insured. Recommendations to this end were made and are summarized. (auth)

14849 CEA-1381

France. Commissariat à l'Énergie Atomique, Paris. APPAREILLAGE D'EXAMEN DES ELEMENTS COMBUSTIBLES DES PILES INDUSTRIELLES DE MARCOULE. (Apparatus for Examination of Irradiated Fuel Elements of Industrial Reactors at Marcoule). P. Pesenti and Ph. Wallet. 1960. 24p.

A viewing and measurement cell is described for the slugs of Marcoule industrial reactors. This cell allows visual inspection and photography of slugs. Length measurements are also made possible by horizontal motion of the slug both in translation and rotation. (auth)

14850 CF-59-11-129

Oak Ridge National Lab., Tenn. MINIATURE TV CAMERA MANIPULATOR. P. P. Holz. Nov. 26, 1959. 25p. Contract [W-7405-eng-26]. OTS.

A device for manipulating a 2 in. Dage TV camera in the annular space between the HRT core tank and pressure vessel was developed and readied for use in the inspection of the damaged core tank wall. The tool consists of a series of hinged arms, each operable relative to the adjacent arms by a hydraulic cylinder. The camera, which can be rotated by means of a small motor drive, is mounted on the last, or the third arm. Lighting is provided by several lamps mounted on the camera head. A central operating panel, which contains the controls and indicators for positioning the camera is mounted at the top of the device and outside the reactor cell. Insertion of the camera involves a stepwise, programmed sequence of movements. Programs have been worked out for positioning the camera in several areas of interest. (auth)

14851 CREL-775

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

TRANSISTORIZED COUNTING SYSTEMS. 9. PUNCHED TAPE TIMESORTER. L. B. Robinson and W. D. Howell. Feb. 1960. 55p. (AECL-989). AECL.

An automatic time-interval recording instrument was built which measures the time interval between two succes-

sive electrical impulses and records each measurement on paper tape. The record is in a form suitable for later analysis by the Datatron. The instrument is described with special reference to its use in neutron time-of-flight experiments. (auth)

14852 HW-SA-1835

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A THERMISTOR DEVICE TO MEASURE ULTRA-SLOW LIQUID SPEEDS. J. D. McCormack. Aug. 4, 1959. 11p. Contract W-31-109-Eng-52. (HW-61257). OTS.

A thermistor device to measure liquid speeds at 25 to 500 ft/day was developed and tested. The operation is satisfactory under conditions of low turbulence and slow temperature changes. The speed of ground water in wells was measured with the device. (J.R.D.)

14853 IFA-FN-20

Academia R. P. R. Institutul de Fizică Atomică, Bucharest.

THE NEUTRON CRYSTAL SPECTROMETER OF THE INSTITUTE OF ATOMIC PHYSICS BUCHAREST. (Spectrometrul de Neutroni cu Cristal al Institutului de Fizică Atomică București). D. Bally, E. Tarină, S. Todireanu, and I. Olteanu. 1959. 12p.

A neutron spectrometer is described which is capable of operating with a plane or bent crystal. (W.D.M.)

14854 KAPL-M-ACL-2

Knolls Atomic Power Lab., Schenectady, N. Y.

AN ELECTRICAL RESISTANCE MEASURING DEVICE FOR DETERMINING THE THICKNESS OF A WELDED MONEL OVERLAY ON CARBON STEEL. A. C. Lind. Apr. 27, 1960. 29p. Contract W-31-109-Eng-52. OTS.

The development and calibration of a device which measures the thickness of a welded monel overlay on carbon steel are described. The device measures the electrical resistance between two points on the surface of the overlay, which is correlated with the overlay thickness. The device provides a measure of the average overlay thickness existing in an area approximately $1\frac{1}{4}$ in. \times $\frac{1}{4}$ in. beneath the measuring probe, and standard deviation of this measurement was found to be less than 0.004 in. in the thickness range 0.000 in. to 0.150 in., and increases to 0.015 in. between 0.150 in. and 0.200 in. (auth)

14855 KAPL-M-RFS-1

Knolls Atomic Power Lab., Schenectady, N. Y.

APPLICATION OF SOLID-STATE DEVICES TO NUCLEAR PLANT TECHNOLOGY. R. F. Shea. Apr. 8, 1960. 10p. Contract W-31-109-Eng-52. OTS.

A review of solid state devices applications in areas of reactor control and instrumentation previously served by electron tubes and magnetic amplifiers is presented. Areas in which their use shows promise, but not yet fully realized, are discussed and some newer devices are described, along with their potential uses. (J.R.D.)

14856 NAVSHIPS-93484

Transistor Applications Inc., Boston.

A HANDBOOK OF SELECTED SEMICONDUCTOR CIRCUITS. Seymour Schwartz, ed. [nd]. 452p. Contract NObS-73231.

Design philosophy and examples of contemporary circuits of direct-coupled amplifiers, low-frequency amplifiers, high-frequency amplifiers, oscillators, switching circuits, logic circuits, a-c to d-c power supplies, power converters, and small signal nonlinear circuits are given. (C.J.G.)

14857 NP-8589

Illinois. Univ., Urbana.

A PROTON PROBE FOR MEASURING MAGNETIC FIELD. Technical Report No. 16. Van Blumel and Santimay Chatterjee. Apr. 22, 1960. 14p. Contract NOnr-1834(05).

A proton resonance device for measurement of homogeneous magnetic fields from 3 to 15 kilogauss is described. Operation of the device is described, and circuit diagrams are presented. (C.J.G.)

14858 ORINS-33

Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.

A LINEAR SCANNER FOR HUMAN RADIOISOTOPE RESEARCH. A. C. Morris, Jr. Mar. 1960. 30p. Contract AT-40-1-GEN-33. OTS.

The design and performance are described of a linear scanner for use in radioisotope research. The linear scanner affords its greatest usefulness in gross scans of human subjects to localize the distribution of isotopic concentrations. Illustrative examples are included. (C.H.)

14859 ORNL-2695

Oak Ridge National Lab., Tenn.

NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958. Apr. 22, 1960. 331p. OTS.

Nineteen papers were presented at the conference. The subjects of the papers cover the four general areas of process instrumentation in high-pressure environments, engineering of safety and control systems, data handling systems, and solid state component instruments. Separate abstracts have been prepared for each paper. (W.L.H.)

14860 ORNL-2695(p.3-12)

General Electric Co. Atomic Power Equipment Dept., [San Jose, Calif.].

PRIMARY ELEMENTS FOR BOILING-WATER REACTORS. B. E. Woodward. p.3-12 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

The instrumentation for the Dresden 180-Mw(net) electric plant is described. The control-room philosophy for the large-scale power plant is one of almost all remote control. While most of the operating functions will be initiated in the control room, operators can perform certain functions and operations at local panels or racks in the turbine building, or in cells or instrument rooms inside the sphere. (W.L.H.)

14861 ORNL-2695(p.40-58)

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

OPERATIONAL EXPERIENCES WITH PRIMARY ELEMENTS AND VALVES IN SLURRY SERVICE. E. A. Goldsmith. p.40-58 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

The operating experiences with primary elements and valves in a corrosion loop operating at high pressure and temperature with 300 to 350 g of ThO₂ per kg of H₂O are described. (W.L.H.)

14862 ORNL-2695(p.59-64)

Westinghouse Electric Corp. [Atomic Power Div.], Pittsburgh.

PRIMARY COOLANT VALVES FOR NUCLEAR PLANTS. E. A. Bake. p.59-64 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

The design, manufacture, and performance of primary

coolant valves for pressurized water reactors are described. (W.L.H.)

14863 ORNL-2695(p.67-85)
Argonne National Lab., Lemont, Ill.
INSTRUMENTS USED IN HIGH-TEMPERATURE SODIUM AT ARGONNE NATIONAL LABORATORY. F. A. Smith. p.67-85 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

The development of flow meters, thermocouples, level indicators, and pressure transmitters for use in the liquid metal systems of the EBR-1 and EBR-2 is described. (W.L.H.)

14864 ORNL-2695(p.86-101)
Pratt and Whitney Aircraft Div., United Aircraft Corp., [Middleton, Conn.].
LIQUID METAL INSTRUMENTATION PRACTICE. P. Bliss. p.86-101 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

The techniques of instrumentation for liquid metal systems as practiced at Pratt and Whitney Aircraft CANEL are reported. The fabrication, testing, and performance of clad thermocouples, liquid metal pressure transmitters, leak detectors, liquid metal level indicators, and electromagnetic flowmeters are described. (W.L.H.)

14865 ORNL-2695(p.102-16)
Brookhaven National Lab., Upton, N. Y.
SPECIALIZED INSTRUMENTATION FOR LIQUID-BISMUTH LOOPS. D. W. Huszagh. p.102-16 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

Instrumentation is described for the operation of corrosion loops through which molten bismuth with various additives is pumped. The specific instruments discussed are as follows: liquid-metal pressure sensor, permanent-magnet flowmeter, and heat-balance-type flowmeter. (W.L.H.)

14866 ORNL-2695(p.155-69)
Westinghouse Electric Corp. [Atomic Power Div.], Pittsburgh.
SYSTEM DESIGN AND INSTRUMENTATION OF IN-PILE TEST LOOPS. M. A. Vogel. p.155-69 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

The most important functions of test-loop instrumentation are control of experimental conditions and maintenance of the safety and continuous operation of the reactor. A description of how this will be accomplished by the Westinghouse Testing Reactor (WTR) loop-control system is presented. (W.L.H.)

14867 ORNL-2695(p.170-8)
Oak Ridge National Lab., Tenn.
SAFETY AND CONTROL OF IN-PILE EXPERIMENTS. E. P. Epler. p.170-8 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

Instrumentation for the protection and safety of a reactor and of in-pile experiments in the reactor is discussed. (W.L.H.)

14868 ORNL-2695(p.179-94)
Atomic Energy of Canada Ltd., Chalk River, Ont.
BUILT-IN TESTING IN PROCESS INSTRUMENTATION. E. Siddall. p.179-94 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

The large-scale use of redundancy and coincidence in instrumentation of the NRX and NRU is discussed. The instruments are assembled into lattices instead of chains. At least three instruments operating as a group are necessary to identify a fault in one instrument in one of the groups. Two will agree; the faulty instrument will disagree. In the built-in testing method, a danger signal is injected into one instrument by a simulation and the system is checked through all outlets of the lattice, and if there is anything wrong, the danger signal does not get through. (W.L.H.)

14869 ORNL-2695(p.195-205)
Oak Ridge National Lab., Tenn.
THE ROLE OF THE INSTRUMENTATION AND CONTROL ANALYST IN POWER REACTOR DESIGN. E. R. Mann. p.195-205 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

Someone must supply the instrument engineer and the control engineer with all the information needed to provide adequate instrumentation and control for a nuclear power plant. This person must know something about the limitations of instruments and control gear. He must also know something about nuclear power plants. He must be able to make the maximum use of the relatively new computer installations at his disposal, to determine what the power plant will do both in steady state and transient conditions, and particularly to determine the behavior of all parts of the system when there is a component failure. From his analyses come the complete performance specifications of all the instruments and all the control systems used on the power plant. (W.L.H.)

14870 ORNL-2695(p.245-58)
Arnold Engineering Development Center, Tullahoma, Tenn.
EXPERIENCE WITH LARGE-SCALE DATA HANDLING SYSTEMS. M. R. Mulkey. p.245-58 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

The Arnold Engineering Development Center (AEDC) is a USAF installation. AEDC consists of a group of wind tunnels and engine test facilities. One of the AEDC's most important functions is the recording and handling of data from tests performed. There are three data-handling systems at the AEDC: one in each of the three test facilities, the Propulsion Wind Tunnel, the Engine Test Facility, and the Gas Dynamics Facility. Each system has an ERA 1102 computer. (W.L.H.)

14871 ORNL-2695(p.259-70)
Knolls Atomic Power Lab., Schenectady, N. Y.
DATA HANDLING SYSTEMS FOR NUCLEAR POWER PLANTS. R. A. Edwards. p.259-70 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

Layouts of data handling systems are presented for nuclear power plants. (W.L.H.)

14872 ORNL-2695(p.273-96)
Foxboro Co., Mass.
MAGNETIC AMPLIFIERS FOR RELIABLE PROCESS CONTROL. H. E. Darling. p.273-96 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

A review of the reliability of magnetic amplifiers for reactor process control is presented. (W.L.H.)

14873 ORNL-2695(p.297-314)
Knolls Atomic Power Lab., Schenectady, N. Y.
TRANSISTOR NUCLEAR INSTRUMENTATION FOR NAVAL APPLICATIONS. J. E. Moran. p.297-314 of NUCLEAR

PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

The advantages and disadvantages of transistor instrumentation over electron tubes and magnetic amplifiers for nuclear naval applications are discussed. (W.L.H.)

14874 ORNL-2695(p.315-23)

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

MAGNETIC AMPLIFIERS FOR NUCLEAR POWER PLANT SAFETY CIRCUITRY. K. H. Kline. p.315-23 of NUCLEAR PROCESS INSTRUMENTATION AND CONTROLS CONFERENCE HELD IN GATLINBURG, TENNESSEE, MAY 20-22, 1958.

The advantages and disadvantages of using magnetic amplifier circuits compared to vacuum-tube circuits for nuclear power plant safety circuitry are discussed. (W.L.H.)

14875 SCTM-95-60(52)

Sandia Corp., Albuquerque, N. Mex.

TRANSISTORIZED AUDIO MIXER PREAMPLIFIER. T. M. Schultheis. Mar. 11, 1960. 9p. OTS.

A transistorized three-channel audio mixer preamplifier which is described will be used in test-range communication systems for the purpose of mixing audio signals and driving the 2-watt Mod 1A or 10-watt Mod 1A amplifier (Refer to SCTM-164-59-52). (auth)

14876 SCTM-107-56(52)

Sandia Corp., Albuquerque, N. Mex.

TRANSISTORS APPLIED TO AN FM-FM AIRBORNE RADIO TELEMETRY SYSTEM. R. H. Gablehouse. May 18, 1956. 74p. OTS.

A qualitative analysis of the physical properties of junction transistors is presented. Parameters customarily used in circuit analysis are derived and a demonstration of their utility is given in the analysis of the modulator stage of the voltage controlled subcarrier oscillator. A short analysis of the current controlled subcarrier oscillator verifies its capability to be used in telemetering thermocouple signals. (auth)

14877 SCTM-114-60(24)

Sandia Corp., Albuquerque, N. Mex.

AUTOMATIC RECORDING UNIT. Frank A. Ross. Mar. 29, 1960. 21p. OTS.

The PT-750 is designed to be used in conjunction with a production tester which requires automatic recording of test data. This manual provides a source of procedures and reference material necessary in automatic recording and in the use of the PT-750. (auth)

14878 UCRL-9000

California. Univ., Berkeley. Lawrence Radiation Lab.

TRANSISTOR COUNTING SYSTEMS FOR SCINTILLATION DETECTORS. Stanley C. Baker, Horace G. Jackson, and Dick A. Mack. Feb. 17, 1960. 23p. Contract W-7405-eng-48. OTS.

The requirements for multiple-coincidence counting systems with 10^{-4} - to 10^{-8} -sec time resolution can be met economically with presently available high-frequency transistors. The design of solid-state coincidence circuits, amplitude discriminators, and decade scalers is considered and their operation discussed. Several systems have been designed utilizing up to 180 channels from scintillation detectors. (auth)

14879 JPRS-2516

SOVIET CONFERENCES ON ELECTRONICS. Fourth Scientific Technical Conference on Nuclear Radioelec-

tronics. A. A. Sanin. Translated from *Pribery i Tekh. Ekspt.* No. 4, 161-3(1959). 34p. OTS.

A summary is given of the information presented at the Fourth Scientific Technical Conference on Nuclear Radioelectronics held in Moscow, April 20 through 25, 1959. (T.R.H.)

14880 M-6613

THE REPRODUCTION OF VOLTAGE IMPULSES BY MEANS OF A PROPORTIONAL AMPLIFIER. (Die Wiedergabe von Spannungsimpulsen durch Einen Proportionalverstärker). U. Cappeller. Translated from *Z. angew. Phys.* 4, 330-45(1952). 42p. JCL.

The reproduction of voltage impulses by means of a proportional amplifier may be treated with the aid of the Laplace transformations. The transmission characteristics of an amplifier can be fully described by the specification of a characteristic function, in which the impulse-deforming influences of the individual hook-up elements of the amplifier are comprehended. The transmission functions of an amplifier of one and several stages are derived and the deformations to which a voltage course is subject are pointed out. (W.D.M.)

14881

SINGLE-CHANNEL TIME ANALYZER FOR THE SPECTROMETRY OF FAST PARTICLES BY THE TIME-OF-FLIGHT TECHNIQUE IN THE NANOSECOND REGION. N. Martalogu, F. Țintă, R. Dumitrescu, I. Korgueva, and M. Molea. *Acad. rep. populare Romîne, Inst. fiz. atomică și Inst. fiz. Studii cercetări fiz.* 10, 515-32(1960). (In Rumanian)

After some considerations on the time-of-flight technique used in the spectrometry of fast particles, on time analyzers, and on the degree of resolution of these installations, the principle of the method of differential coincidence is described. The scheme of the analyzer, which is the delayed coincidence type, is discussed. The operational conditions used in the testing of the analyzer are indicated, and characteristic curves illustrating the performance are given. In autocoincidence work both with electric pulses of constant amplitude and with luminescent pulses, an intrinsic resolution time of $\tau_0' = 2.5 \times 10^{-11}$ sec with an efficiency of 100% was obtained. In normal operating conditions with two photomultipliers, a resolution time $\tau_0'' = 2.1 \times 10^{-10}$ sec was obtained independent of the duration of the input pulses with an efficiency of 100%. The sensitivity of the device is approximately 0.2 to 0.3 v. The performance of the analyzer is illustrated with a measurement of the velocity of light in air at a distance of 20 cm and with an error less than 5%. (tr-auth)

14882

DEVELOPMENT, CALCULATION, AND PLANNING OF HELICAL NEUTRON CHOPPER. George Ionescu. *Acad. rep. populare Romîne, Inst. fiz. atomică și Inst. fiz. Studii cercetări fiz.* 10, 559-80(1960). (In Rumanian)

The development of the helical neutron chopper is briefly reviewed, and the characteristics of the ones existing are tabulated and discussed. The resolution and the transparency of the choppers are calculated. (J.S.R.)

14883

A FAST AND STABLE AMPLITUDE ANALYZER. D. Dorcioman, V. Cojocaru, and M. Cristu. *Acad. rep. populare Romîne, Inst. fiz. atomică și Inst. fiz. Studii cercetări fiz.* 10, 591-5(1960). (In Rumanian)

A block diagram is given of a fast stable pulse analyzer designed for use with scintillation detectors. The characteristics of the analyzer are determined, and typical results obtained with it are reported. (J.S.R.)

14884

AMPLITUDE ANALYZER WITH ELECTROSTATIC MEMORY. A. Segal. Acad. rep. populare Romîne, Inst. fiz. atomică și Inst. fiz. Studii cercetări fiz. **10**, 791-805 (1959). (In Rumanian)

A pulse analyzer with electrostatic memory and ordinary cathode tube is described. The apparatus has 64 channels, the capacity of each being 2^{16} to 1. The maximum statistical number of pulses analyzed is 200/sec. The spectrum is permanently visible on the screen of the cathode tube in the binary system of numeration. The possibility of blocking the analysis of certain pulses by the control, in coincidence, of some "veto" pulse and of extending a portion of the spectrum studied to all 64 channels is predicted. (tr-auth)

14885

INSTRUMENTAL AND TECHNICAL NOTES. A DOSE-RATE RADIOMETER. M. J. Hill (Clatterbridge Hospital West, Bebbington, Ches., Eng.). Brit. J. Radiol. **33**, 331-2 (1960) May.

Design features are described of a rate meter for use in preparing x-ray depth dose charts for the 4-Mv linear accelerator. (C.H.)

14886

THE SCINTILLATION CHAMBER. Y. Koechlin, B. Agrinier, B. Parlier, and A. Tarrius. Bull. inform. sci. et tech. (Paris) No. 37, 2-11(1960) Feb. (In French)

The scintillation chamber is a device which allows the path of a charged particle to be seen. It consists of a solid or liquid phosphor (the conventional phosphor of the scintillation counter) associated with a light amplifier circuit. The chamber is compared with a propane bubble chamber. The engineering problems in its construction are discussed, and the properties are described. (J.S.R.)

14887

BULLETIN OF TECHNICAL INFORMATION NO. 4. NUCLEAR INSTRUMENTATION. Bull. inform. sci. et tech. (Paris) No. 37, 12-27(1960) Feb. (In French)

The program for the electronic testing of counting devices is outlined. Studies being made on the development of detectors, counters and selectors, personnel monitors, amplifiers, prospection apparatus, and measurement apparatus are described. (J.S.R.)

14888

ABSOLUTE MEASUREMENT OF Au¹⁹⁸ (INTERCOMPARISON WITH HARWELL). Djordje N. Bek-Uzarov, Vlastimir F. Bulović, Dragica R. Popović, and Vladeta V. Urošević. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade) **10**, 19-24(1960) Mar. (In English)

The techniques and methods developed for primary standardization of Au¹⁹⁸ are described. The results obtained by solid angle, beta-gamma coincidences, and 4π counter methods, were compared with Harwell's results on the same gold foils and agreement was found within the limits of the 2 to 6% estimated error. (auth)

14889

THORIUM FISSION CHAMBER. Fedor M. Boreli. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade) **10**, 25-6 (1960) Mar. (In English)

A simple fission chamber using thorium as the fissionable material for fast neutron flux measurement is described. The technique for preparing thin thorium films is presented. (auth)

14890

A POSSIBILITY FOR THE MEASUREMENT OF THERMAL

NEUTRON FLUX WITH EMULSIONS IN GEL FORM.

M. Jurić, D. Winterhalter, and M. Dordević. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade) **10**, 27-32(1960) Mar. (In English)

Emulsions in gel form loaded with boron, lithium, and uranium were used. Results of measurements obtained with these emulsions are compared with those made with Ilford plates loaded with boron. Errors of measurements are determined and an efficient method for the determination of neutron flux is suggested. (auth)

14891

LOW PRESSURE EXPANSION CLOUD CHAMBER.

Ajdačić S. Vladimir, Cerineo A. Miho, Dimitrijević Dj. Živan, and Milojević B. Aleksandar. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade) **10**, 33-42(1960) Mar. (In English)

A pressure defined expansion cloud chamber, operating at final pressure of 2 to 3 mm Hg, was constructed. Satisfactory results were obtained by cooling the entire chamber and lowering the saturation pressure of different vapors used. However, better results were attained using nonsaturated vapors without the cooling system. The best track conditions for different initial pressures were investigated and determined by changing the ratio of the partial pressures of unsaturated vapors and permanent gas. The experimental results are analyzed and discussed. (auth)

14892

A HIGH RESOLUTION BINARY AND DECADE COUNTING UNIT. Anton A. Šrebel. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade) **10**, 101-6(1960) Mar. (In English)

The effect of loading capacitances, limitations of voltage change during the transition time and tube characteristics on the switching speed of a bistable multivibrator was studied. A fast binary, using two EL80F tubes and having a time resolution of 2×10^{-8} sec, is described. A decade counting unit, based on the $8 + 2$ system of the previously described binaries, showed a resolution of 5×10^{-8} sec. (auth)

14893

THE INCLINED SOURCE IN THE PERMANENT MAGNET SPECTROMETER. R. Stepić and M. Mladenović. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade) **10**, 175-6 (1960) Mar. (In English)

A method for the improvement of the resolution of alpha and beta nuclear spectra is described; it consists of inclining the source in the magnetic spectrometer in such a way as to make an angle of 60 to 80° with the plane of the photographic film. Thin sources are needed, and the optimum angle depends on the radius of curvature as well as source thickness. This method should be useful in measurement of lines close together, e.g., L lines. Data which show a 30 to 40% improvement in resolution are presented for some conversion lines from Ir¹⁹². (D.L.C.)

14894

DISCHARGE REACTIONS IN THE ION SOURCE OF MASS SPECTROMETERS. V. Čermák and Z. Herman (Czechoslovak Academy of Sciences, Prague). Collection Czechoslov. Chem. Commun. **25**, 1210-13(1960) Apr. (In German)

Peaks in the mass spectra of rare gases, nitrogen, carbon dioxide, and carbon monoxide at very high pressures in ion sources are described. The position of the peaks depends on the magnitude of the extraction voltage. Peaks are attached to ions originating in definite sections of the ion sources as a result of discharge reactions. (tr-auth)

14895

FAST COUNTING CIRCUITS USING E1T TUBES. V. Ra-

deka (Instituta "Rudjer Boskovic," Zagreb). Electronic Eng. 32, 92-5(1960) Feb.

The possibilities of fast counting with EIT type counter tubes are investigated. Displacement of the electron beam is considered and time required to reach the stable point calculated. The limits of accurate counting against the reliability required are determined theoretically and experimentally. It is found possible to use EIT tubes up to about 10^6 pulses per second. A circuit diagram of a reliable fast counting decade suitable for general application is presented. The circuit operation is entirely independent of the input waveform and supply voltage variations. Only one d-c supply voltage is needed. (auth)

14896

THE MONITORING OF RADIOACTIVITY IN THE AIR AND IN WATER. Sandor Bisztray-Balku (Power Plant Designing Bureau). Energia és Atomtech. 12, 255-63(1959) May-June. (In Hungarian)

Natural and artificial radioactivity are described, and the various methods and techniques for detecting and measuring radioactive contamination are reviewed. A photograph, two sketches, and a technical description of a Frieske-Hoepfner continuous monitor are given. It is recommended that such instruments be used to monitor the area surrounding Hungary's research reactor [in Csillebér], in a radius of 500 to 1000 m from the 80-m stack. If for reasons of economy only one monitor is acquired, it should be truck-mounted or set up in the direction of the prevailing northwestern winds. The reactor is water-moderated and water-cooled. It uses 10% enriched U, Al clad. (JPRS)

14897

A CRITICAL STUDY OF THE METHODS FOR THE CONTINUOUS MEASURING OF ABSORPTION WHEN GAMMA-ACTIVE SOURCES ARE USED. Janos Kakas (Csepel Iron and Steel Works). Energia és Atomtech. 12, 623-7(1959) Dec. (In Hungarian)

Nuclear instruments are compared with regard to their use as detectors in gaging the thickness of moving sheet metal with gamma rays. The G-M counter is ruled out because of its dead time and low sensitivity to gamma rays. Computations are presented to show that for an ionization chamber the gamma-active source must be 600 times stronger than for a scintillation counter using a sodium iodide crystal. Laboratory tests are described which show that the pulse-type scintillation counter is more sensitive than the current-type and is not distorted by voltage variations. (JPRS)

14898

THE QUANTITATIVE IN VIVO DETERMINATION OF INCORPORATED GAMMA RAY EMITTERS. V. Lenger (Inst. of Industrial Hygiene and Occupational Diseases, Prague). Folia Biol. (Prague) 6, 85-95(1960). (In English)

A simple and easily available method is described for the rapid determination of the activity of gamma emitters within the human body. A possible disadvantage rests in the necessity to know the type of radioisotope that is being measured. (C.H.)

14899

IMPROVEMENT OF THE PLATEAU OF GEIGER-MUELLER COUNTERS WITH METALLIC SHELL AND ARGON-ALCOHOL FILLING. J. Kern and O. Huber (Université, Fribourg, Switzerland). Helv. Phys. Acta 33, 27-52(1960). (In French)

The construction of a metallic Geiger-Mueller counter is described. Spurious counts are successfully suppressed by

a careful choice of wire diameter. For the elimination of end effects a new arrangement with two concentric guard rings was finally developed. With an argon-alcohol mixture, the plateau shows a slope of 0.6% over 150 volts in "homogeneous" irradiation. Using a collimated beam of gamma rays, 0.24% over 160 volts is obtained. It is shown that in the latter case the residual slope is due exclusively to the decreasing of the deadtime with increasing overvoltage. (auth)

14900

NONSATURATING TRANSISTOR CIRCUITRY FOR NANO-SECOND PULSES. Robert M. Sugarman (Brookhaven National Lab., Upton, N. Y.). IRE Trans. Nuclear Sci. NS-7, 23-8(1960) Mar.

A system is described for pulse testing transistors in the 10^{-10} to 10^{-9} sec range. Based on these measurements, a nanosecond, current switching, multiple coincidence system has been constructed. It is d-c coupled and has input pulse limiters and clipping stubs. A ten-nanosecond scaler-discriminator stage is discussed which also employs current switching techniques. One output is scaled for pulse counting; another unscaled output is used to drive coincidence circuitry. (auth)

14901

BACKGROUND PULSE PILE-UP IN NEUTRON COUNTING CHANNELS. J. L. Burkhardt (Hermes Electronics Co., Cambridge, Mass.) and R. C. Wilson (Westinghouse Electric Corp., Pittsburgh). IRE Trans. Nuclear Sci. NS-7, 36-43(1960) Mar.

An experimental study of background pulse pile-up in neutron counting channels was performed. Neutron and gamma-produced pulses from two BF_3 -filled counters and one boron-lined counter were photographed for several input circuit time constants. Several measurements were made for each of ten counting channels: five commercially available circuits, three Bettis reactor source range channels, and two experimental systems. Integral bias curves taken with simulated neutron and gamma pulses were the major comparison criterion. Wide differences in performance were found, even among very similar circuits. The results indicate that small pulse pile-up in the test circuitry may greatly influence data taken with counters operating in high-background gamma fluxes. Recommendations are made for the design of circuitry with reduced pile-up. (auth)

14902

DIGITAL STORAGE OF STATISTICAL DATA. Fred H. Irons (Massachusetts Inst. of Tech., Cambridge). IRE Trans. Nuclear Sci. NS-7, 43-8(1960) Mar.

In the field of nuclear instrumentation, there is need for an economical instrument capable of storing data compactly in digital form. A magnetic tape recorder is described which can store binary numbers from one to a maximum of eleven digits in parallel on a continuously rotating loop of tape. The tape is operated at a constant speed of 30 inches per second and a packing density of 667 bits/inch/track and can be used in loops of two to 1000 feet. For these operating conditions, the average storage access time for random inputs is 25 μsec . Stored data are read back from the tape into a core-memory matrix at a 20-kc rate. The operational reliability for the recording and reading processes has been found to vary between 4 and 14 parts/million. Higher reliability may be obtained by using the tape at lower packing densities. (auth)

14903

THE RESOLVING POWER AND LUMINOSITY OF A β SPECTROGRAPH USING A MAGNETIC FIELD WITH

R⁻¹. C. Bastard and J. Lafoucrière (Université, Lyon). J. phys. radium **21**, 112-14(1960) Feb. (In French)

Previously the characteristics of a β spectrograph using an inhomogeneous magnetic field of constant rH were studied. Now, the position of the diaphragms, the resolving power, and the luminosity are studied. The latter is excellent, but the resolving power is limited by the dimensions of the spectrograph. (auth)

14904

SELF-SEALING THERMOCOUPLE GLAND. H. L. Foltz and W. R. Brown (Goodyear Atomic Corp., Portsmouth, Ohio). Machine Design **32**, No. 10, 176(1960) May 12.

A thermocouple designed to have fast response to rapid temperature changes and to be self-sealing is described. It consists of thermocouple wires running through a Teflon core which is enclosed by a brass shell and a packing nut. When the whole assembly is attached (soldered) to the tube or duct whose temperature is to be measured and the packing nut is tightened, the core is compressed so that no leakage can occur. (D.L.C.)

14905

HELIUM-BUTANE GAS MIXTURES AS FILLINGS FOR GEIGER-MÜLLER TUBES. V. Moses and J. F. Fowler (King's Coll. Hospital, London). Nature **186**, 538-9(1960) May 14.

Certain helium-butane mixtures were found to give good performance as counting gases in gas-flow counters employing Geiger-Mueller tubes. (C.H.)

14906

PRELIMINARY FLIGHT TESTS OF AN ATOMIC CLOCK IN PREPARATION OF LONG-RANGE CLOCK SYNCHRONIZATION EXPERIMENTS. Friedrich H. Reder and Gernot M. R. Winkler (Army Signal Research and Development Lab., Fort Monmouth, N. J.). Nature **186**, 592-3(1960) May 21.

Flight experiments are described for the preliminary synchronization of atomic clocks aiming at an error of less than 1 μ sec between clocks separated by more than 1,000 miles. Design features of the clock and the testing equipment are described and results are presented graphically. (C.H.)

14907

SCINTILLATION COUNTING OF CARBON-14. David S. Jenkinson (Rothamsted Experimental Station, Harpenden, Eng.). Nature **186**, 613-14(1960) May 21.

A precise method is described for the radioassay of carbon-14 in aqueous solutions. The method was developed for use in work on the decomposition in soil of plant material labeled with carbon-14 and is suitable for handling large numbers of samples with specific activities of 0.1 to 10 μ c. The radioactivity of the weak beta emitter is determined by counting the pulses of light emitted by a plastic phosphor in contact with a solution of the isotope. (C.H.)

14908

APPARATUS FOR THE INVESTIGATION OF HEAVY ION INDUCED REACTIONS. Carl E. Anderson, Arthur R. Quinton, William J. Knox, and Robert Long (Yale Univ., New Haven). Nuclear Instr. & Methods **7**, 1-10(1960) Apr. (In English).

An integrated system for studying nuclear reaction mechanisms is described, including detection and identification of particles, and analysis and storage of data. Reaction products ranging from protons to fission fragments are identified and their energies are measured. Observations are made with 1° angular resolution at any angle from 8½° to 171½°. Without loss of vacuum the detectors may be

moved or calibrated and the target may be changed. By a combination of photographic recording and multichannel analysis, products with cross sections ranging down to fractions of a millibarn can be measured in the presence of products having large cross sections. Examples are shown of spectra of protons, alpha particles, fission fragments and fragments ranging from lithium to magnesium produced by heavy ion bombardment. (auth)

14909

RECENT DEVELOPMENTS OF BETA SPECTROMETERS. Milorad Mladjenović ("B. Kidrich" Inst. of Nuclear Sciences, Belgrade). Nuclear Instr. & Methods **7**, 11-21 (1960) Apr. (In English).

A review is given of recent experimental and theoretical developments in beta spectrometry. The most critical points for further development of beta spectrometers are briefly discussed. Some new proposals are mentioned. (auth)

14910

SOME METHODS IN THE PREPARATION OF RADIOACTIVE MATERIALS FOR USE IN BETA-SPECTROSCOPY. W. Parker, M. De Cröes, and K. Sevier, Jr. (Univ. of Uppsala). Nuclear Instr. & Methods **7**, 22-36(1960) Apr. (In English)

The initial results of an investigation dealing with the most appropriate methods for the preparation of radioactive materials for use in beta-spectroscopy are reported. A short review of the methods and techniques developed for this type of preparation is presented, and, where possible, improvements are suggested. The investigation was carried out in four main parts, namely, thin film preparation and thickness determination, electro- and vacuum deposition, and miscellaneous techniques, and is reported in the same order. Tables designating the deposition efficiencies obtained from the preparation of 45 different radioactive materials by employment of the various methods are given. (auth)

14911

THE SEPARATING OF PARTICLES ACCORDING TO THEIR IONIZATION VALUE IN SEVERAL SCINTILLATION COUNTERS. Yu. K. Akimov, V. I. Komarov, O. V. Savchenko, and L. M. Soroko (Joint Inst. for Nuclear Research, Dubna, USSR). Nuclear Instr. & Methods **7**, 37-44(1960) Apr. (In English)

A telescope of scintillation counters is described by means of which it is possible to register rare processes of particle emission with high ionization and small range against a background of outside radiation with smaller ionization. Both normal plastic scintillators 6 mm thick and filmlike scintillators 0.5 mm thick on a polystyrene base with the addition of 1% of tetraphenylbutadiene were used in the counters. The counting responses of the telescope are given for the separation of deuterons from protons with the impulse $p = 900$ Mev/c, He^3 from deuterons with the impulse $p = 730$ Mev/c, and also for α -particles with the energy 800 Mev. The apparatus described has been used in experiments, investigating the processes: $p + d \rightarrow \pi^+ + \text{H}^3$, $d + d \rightarrow \text{He}^3 + n$, $d + d \rightarrow \pi^0 + \text{He}^4$. (auth)

14912

A LINEAR GATE OF 10 TO 100 μ sec DURATION. G. B. B. Chaplin and A. J. Cole. (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Instr. & Methods **7**, 45-9(1960) Apr. (In English)

A simple and reliable linear gate which uses 2 diodes and a transformer is described as part of a system which includes a pulse stretching amplifier and fast gate-pulse

generator. The gate has a switching time of 5 μ sec and accepts input signals with amplitudes ranging from 150 mv to 5v. The amplifier produces output pulses of 5 μ sec duration with 1% linearity in the range 2 ma to 70 ma. A constant error of 1 ma at the output is introduced by the gate while the signal breakthrough is less than 1% over a wide range of temperatures. Details of a high-level amplifier which is suitable for use with present day pulse analyzers are included. (auth)

19413

TIME-AMPLITUDE CONVERTER WITH HIGH RESOLUTION. S. Gorodetzky, R. Richert, R. Manquenouille, and A. Knipper (Université, Strasbourg). Nuclear Instr. & Methods 7, 50-5(1960) Apr. (In French)

A fast time-to-amplitude converter is described which secures reliable operation. Its intrinsic resolution is of the order of 10^{-10} sec. The resolution curve for Co^{60} gamma rays exhibits a full width at half maximum of about 4×10^{-10} sec. Further improvements of the apparatus are indicated. (auth)

14914

A TOTAL ABSORPTION GAMMA RAY SPECTROMETER COMBINING SODIUM IODIDE AND PLASTIC SCINTILLATORS. William H. Ellett and Gordon L. Brownell (Massachusetts General Hospital, Boston). Nuclear Instr. & Methods 7, 56-62(1960) Apr. (In English)

An 18 in. \times 18 in. plastic well scintillator is used to monitor the escape radiation from a 5 in. D NaI well crystal. Coincident events in both scintillators are rejected by means of an anticoincidence circuit. The detectors are mounted in a 2 ton lead and mercury shield so they can be used for the radioassay of low activity samples. Design of electronic equipment used with the plastic scintillators is considered and data are presented on the effectiveness of the anticoincidence mantle in improving the performance of the NaI crystal by (a) reducing the Compton spectrum, (b) increasing its efficiency as a sum spectrometer, and (c) reducing its background spectra. Expressions are derived for the efficiency of the plastic mantle in detecting escape radiation from the NaI crystal and compared to experimental data. (auth)

14915

DETECTION OF NEUTRON AND PHOTON INDUCED FISSION BY $\text{ZnS}(\text{Ag})$ MIXED WITH URANIUM AND THORIUM COMPOUNDS. Nicolai Mitrofanov and J. J. Van Loef (Universidad de Chile, Santiago). Nuclear Instr. & Methods 7, 63-6(1960) Apr. (In English)

A description is given of a scintillator consisting of $\text{ZnS}(\text{Ag})$ mixed with uranium and thorium compounds. The absolute counting efficiency for fast neutron fission is $3.2 \pm 0.6 \times 10^{-3}\%$, and $5.4 \pm 1.0 \times 10^{-3}\%$ for U and Th compound mixtures. The efficiency is within the experimental error independent of the neutron energy between 2 and 3.6 Mev. The scintillator is shown to be useful for photofission studies due to its very low sensitivity for γ rays. (auth)

15916

HIGH RESOLUTION NEUTRON SPECTROSCOPY. H. W. Newson and R. M. Williamson (Duke Univ., Durham, N. C.). Nuclear Instr. & Methods 7, 67-72(1960) Apr. (In English)

The current state of high resolution spectroscopy with a Van de Graaff accelerator is reviewed. For neutrons in the kev region, resolutions of about 3% at 10 kev and 0.7% at 100 kev were attained. The resolution for 2 Mev protons is about 1.5×10^{-4} ; very large ion currents are feasible at this resolution. (auth)

14917

COMBINATION OF MAGNETIC ANALYZERS IN NUCLEAR REACTION EXPERIMENTS. Bo Sjögren (Nobel Inst. of Physics, Stockholm). Nuclear Instr. & Methods 7, 76-88 (1960) Apr. (In English)

Different ways to increase the counting rate in measurements with magnetic analyzing systems are investigated. It is assumed that a good energy resolution is desirable and that the energy spread of the beam from the accelerator (cyclotron) is fairly large. The effect of combining the analyzers suitably, as well as the influence of the type and the setting of the target, are discussed. Two types of systems are considered, namely, analyzers with coincident and with perpendicular bending planes. In both of these cases the energy spread caused by the finite opening angle of the second analyzer is treated, being of importance for reactions with light nuclei. It is found that it should be possible to use a quite large target spot and thick target layer if the measurement is arranged in the proper way. The following circumstances are then important: the dimensions of the system and type of reaction, the bending direction and field gradient of the second analyzer, the target orientation and density, and the detector position. The calculations are illustrated by some numerical examples. (auth)

14918

THE SPATIAL INTEGRATION OF NEUTRON FIELDS WITH MOVING NEUTRON DETECTORS. Walter Hage (Gemeinsame Kernforschungsstelle, Mol, Belg.). Nukleonik 2, 73-9(1960) Apr. (In German)

Motion equations for probes or counter tubes were derived whose importance activation or pulse number is proportional to the amplitude of a known eigenfunction or the mean value of the neutron flux in plane, cylindrical, and spherically symmetrical media. The possible applicability of the method was shown by examples of the measurement of the neutron path length in an infinite expanding medium and the measurement of the material flux curvature in a cylindrical medium. (tr-auth)

14919

IMPULSE AMPLIFIER WITH A TYPE W1-1 DISCRIMINATOR. W. Rytel (Inst. of Physics, Polish Academy of Sciences, Warsaw). Postępy Fiz. 9, 587-91(1958) Sept.-Oct. (In Polish)

A new impulse amplifier design with a type W1-1 diode discriminator is described. It permits a hundredfold amplification of positive impulses with a duration of 10 μ sec at a maximum amplitude of the output impulse around 30. Specifications and a circuit diagram are included. The instrument is basically intended for amplification of positive impulses, but will also amplify negative impulses when the diode discriminator is disconnected. Although the design develops no basically new ideas, it may prove useful in the laboratory. (JPRS)

14920

TIME-OF-FLIGHT NEUTRON SPECTROMETER. H. Tojia, P. Timig, and C. Lazarovici. Rev. phys. 4, 327-36(1959). (In French)

The electronics of the time-of-flight neutron spectrometer are considered in detail. A simplified scheme of the spectrometer is given to explain its operation. The detailed design of the spectrometer is then considered and discussed. The circuits for the pilot oscillation, matrix elements and input, pulse generators, and channel generator are given. (J.S.R.)

14921

NEVIS SYNCHROCYCLOTRON SLOW NEUTRON VE-

LOCITY SPECTROMETER. J. Rainwater, W. W. Havens, Jr., J. S. Desjardins, and J. L. Rosen (Columbia Univ., New York). *Rev. Sci. Instr.* **31**, 481-9(1960) May.

A high-intensity, high-resolution neutron velocity selector system, employing the Nevis synchrocyclotron as a source of pulsed neutrons, is described. Detector counts are accumulated in a 2000-channel analyzer with 0.1- μ sec channel width. Punch card data reduction techniques are discussed. Resonance spectra of PbI_2 obtained using a 35-m flight path provide an example of the resolution and illustrate the use of the self-indication capture γ -ray detector scheme extensively employed. (auth)

14922

BALLISTIC PARTICLE SIZE SEPARATOR. John H. McGinn and John T. MacWaters (Univ. of Pennsylvania, Philadelphia). *Rev. Sci. Instr.* **31**, 513-16(1960) May.

A new type of instrument for the size classification of airborne particulate matter is described. This apparatus operates on an aerodynamic principle and effects ordered size separation of both liquid and solid particles. Calculations of the spatial separation as a function of size for spherical particles of unit density are in accord with preliminary experimental data for diameters between 10 and 100 μ . Application of this principle to aerosol size-frequency analyses is discussed briefly. (auth)

14923

HIGH TEMPERATURE HIGH VACUUM RESISTANCE FURNACE. Julius Cohen and William Eaton (General Telephone & Electronics Labs., Inc., Bayside, N. Y.). *Rev. Sci. Instr.* **31**, 522-5(1960) May.

An experimental high-temperature high-vacuum furnace with self-supported tungsten resistance heating elements is described. The furnace is assembled from readily obtainable parts, and knife-edge vacuum seals are used throughout. The volume of the hot chamber is approximately 2 in. diameter by 8 in. high; the uniform zone is 2 in. long. A temperature of 2000°C can be attained at a pressure of $\sim 10^{-5}$ mm Hg and at a power expenditure of 12 kw. (auth)

14924

EFFECT OF GASEOUS IMPURITIES ON BF_3 PROPORTIONAL COUNTERS. J. Davila Aponte and S. A. Korff (New York Univ., New York). *Rev. Sci. Instr.* **31**, 532-6(1960) May.

The effects which SiF_4 , SO_2 , and SF_6 have on the plateau and the pulse size distribution of a proportional counter were investigated. SiF_4 was tested at three pressures, 30, 45, and 60 cm, of BF_3 and its effect was found to be independent of the counter pressure for the range of value considered. From the variation in the plateau, the attachment probability for SiF_4 was calculated to be $h = 1.485 \times 10^{-5}$ and its cross section for attachment to be $\sigma_a = 5.12 \times 10^{-28}$ cm². The amount of these gases permitted, without the counter being affected beyond the limits of tolerance which are set up, were found to be 0.04% for SiF_4 , 0.01% for SO_2 , and $2.0 \times 10^{-4}\%$ for SF_6 . (auth)

14925

DOUBLE FOCUSING ZERO DISPERSION MAGNETIC SPECTROMETER. R. A. Alvarez, K. L. Brown, W. K. H. Panofsky, and C. T. Rockhold (Stanford Univ., Calif.). *Rev. Sci. Instr.* **31**, 556-64(1960) May.

A double focusing zero dispersion magnetic spectrometer was constructed having the following properties: The spectrometer consists of two magnets, each $n \approx 0.25$, 110° deflection, 30-in. radius of curvature, bending

the particles in the same sense. For the central momentum p_0 , the useful solid angle Ω_0 is ~ 0.0055 ster with a possibility of improvement to 0.01 ster. The momentum acceptance Δp is in excess of $\pm 4\%$ with a useful solid angle Ω of ~ 0.0015 ster at the 4% points. For a point source and for the solid angles and momentum acceptances given, over 90% of the trajectories terminate within a circle of 2-in. diameter at the focal plane. (auth)

14926

OPERATION OF HYDROGEN BUBBLE CHAMBERS IN HIGH-ENERGY PHOTON BEAMS. Duane C. Gates, Robert W. Kenney, Donald A. McPherson, and William P. Swanson (Univ. of California, Berkeley). *Rev. Sci. Instr.* **31**, 565-9(1960) May.

Operation of the Alvarez 4-in. hydrogen bubble chamber in a high-energy photon beam is described, the techniques employed in several modes of operation are discussed, and the corresponding bubble chamber conditions are tabulated. Reduction of electron background was accomplished by beam hardening and by using a Mylar beam-entrance window on the chamber. (auth)

14927

ORGANIC SCINTILLANTS FOR PULSE SHAPE DISCRIMINATING NEUTRON COUNTERS. H. O. Funsten and G. C. Cobb (Univ. of Virginia, Charlottesville). *Rev. Sci. Instr.* **31**, 571-2(1960) May.

Two fluorescence components with differing decay times are exhibited by certain phosphors upon particle bombardment. The ratio of the slow component to the fast one depends on the type of particle causing fluorescence, and this effect can be used to differentiate between gamma rays and neutrons. A circuit for the estimation of such ratios is described and was found to be useful in detecting fast neutrons in a gamma-ray background. Results are presented for several organic phosphors: stilbene, anthracene, Plasti fluor, benzene, deuterobenzene, NE 314, Liquid scintillator No. 3 (active agents are terphenyl and diphenylhexatriene), and NE 202. When used in conjunction with a pulse discriminator circuit, the method yields a neutron to gamma discrimination ratio of 3000 to 1. (D.L.C.)

14928

EFFECTIVE BACKGROUND SHIELD FOR LOW ACTIVITY MEASUREMENTS. Antti P. U. Vuorinen (Finland Inst. of Tech., Helsinki). *Rev. Sci. Instr.* **31**, 573-4(1960) May.

The design of a background shielding system for low activity measurements in small samples is given and consists of a sample chamber surrounded by pure copper rings and an old iron gun barrel. The attenuation of the background by this system is compared with that by either the iron barrel or the copper rings alone, and a conventional lead shield; it is found to be superior. (D.L.C.)

14929

IMAGE INTENSIFICATION BY TRANSMISSION SECONDARY ELECTRON EMISSION. M. M. Wachtel, D. D. Doughty, G. Goetze, A. E. Anderson, and E. J. Sternglass (Westinghouse Research Labs., Pittsburgh). *Rev. Sci. Instr.* **31**, 576-8(1960) May.

The successful operation of a multistage image intensifier using a series of aluminum dynodes coated with thin layers of BaF_2 and reinforced with very fine wide-mesh grid is reported. The electron gain in the best of these tubes is 2400, corresponding to an average secondary emission ratio of 7 per dynode. The photon gain with 15-kv acceleration from the last dynode to a P11 output phosphor is about 10,000. At low light levels, resolution is

limited by photoelectron noise. This tube, when fully developed, will be well suited to the amplification of extremely low light level images such as those encountered in astronomy, nuclear particle track photography, spectroscopy, and x-ray fluoroscopy. (D.L.C.)

14930

CHERENKOV DETECTOR ACCURATELY MEASURING VELOCITY AND DIRECTION OVER A WIDE RANGE. Arthur Roberts (Univ. of Rochester, N. Y.). *Rev. Sci. Instr.* **31**, 579-80(1960) May.

The design of a detector for Cherenkov radiation is given and consists of a cascaded system of image-intensifier tubes in conjunction with a radiator and a camera. The detector is believed to be capable of precise measurements of particle velocity even in the highly relativistic range, of the determination of the direction, and of making such observations on several particles at the same time. The radiation intensity needed is small, although a little larger than that needed for photomultiplier detection. A 6- to 10-cm path for a cone angle of 15° is sufficient for a good ring image of the Cherenkov radiation. Accuracies of ± 0.0001 to 0.0005β in the relativity ratio and of ± 0.002 rad in the direction appears possible. The detector should be useful in distinguishing high-energy particles and in identifying the products of high-energy interactions. (D.L.C.)

14931

NUMERICAL CALCULATION OF THE POTENTIAL DISTRIBUTION IN ION SLIT LENS SYSTEMS. [PART] II. A. J. H. Boerboom (Laboratorium voor Massaspectrografie, Amsterdam). *Z. Naturforsch.* **15a**, 244-52(1960) Mar. (In English)

The potential distribution is computed in certain ion slit lens systems, consisting of three parallel slits in three parallel electrodes. In a previous paper (*Z. Naturforsch.* **14a**, 809(1959)) the case was treated where the slit widths were smaller than the distances to the neighboring electrodes. In the present paper this requirement has been dropped; for the sake of simplicity, however, the computations are confined to the case, where the central electrode represents a plane of symmetry. Various approximation and iteration methods are given to find the necessary parameters to perform the Schwarz-Christoffel transformation. Several typical examples are given. (auth)

14932

NUMERICAL CALCULATION OF THE POTENTIAL DISTRIBUTION IN ION SLIT LENS SYSTEMS. PART III. A. J. H. Boerboom (Laboratorium voor Massaspectrografie, Amsterdam). *Z. Naturforsch.* **15a**, 253-9(1960) Mar. (In English)

In previous papers the potential distribution was calculated in ion slit lens systems, consisting of three slits in three parallel electrodes and satisfying certain conditions concerning their shape. In the present paper the computing methods are generalized to slit systems of an arbitrary number of electrodes, with the only restriction being that slits broader than the distances to neighboring slits are separated by slits narrower than the respective distance, and that a pair of electrodes with a mutual distance smaller than their slit widths are separated from the neighboring slits by distances greater than the respective slit widths. For slit systems satisfying this condition the parameters are computed necessary to perform the Schwarz-Christoffel transformation. Formulas are given to compute the potential distribution and field strength. In a typical example the potential distribution and field

strength are computed in the region around two parallel electrodes with broad slits compared with the distance between the electrodes. (auth)

14933

ERRORLESS-IMAGE MASS SPECTROMETER WITH RADIAL INTERMEDIATE IMAGE. H. Wollnik and H. Ewald (Technische Hochschule, Munich). *Z. Naturforsch.* **15a**, 265-7(1960) Mar. (In German)

As a continuation of an earlier report (*Z. Naturforsch.* **14a**, 842 (1959)) on two easily obtainable double-focusing mass spectrometers with radial intermediate image, 69 additional apparatuses of the same sort were calculated. With an apparatus of toroid condensers and homogeneous magnetic fields, double focusing at a point in the first and second approximation was obtained. The results of the calculations of the variables of the spectrometers are presented. (J.S.R.)

14934

A CRYOSTAT FOR NEUTRONOGRAPHIC INVESTIGATIONS. R. A. Alikhanov. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 806-8(1960) Mar. (In Russian)

A low temperature (including helium temperatures) cryostat is described which can be employed to study scattering of thermal neutrons on polycrystalline samples. (auth)

14935

REMOTE-CONTROL MANIPULATOR. (to U. S. Atomic Energy Commission). British Patent 834,244. May 4, 1960.

A master-slave arm remote manipulator is described. (T.R.H.)

14936

IMPROVEMENTS IN AND RELATING TO ELECTRICAL MEASURING MEANS FOR NUCLEAR REACTORS. John Jeffrey Stubbs, Dennis Michael Watts, and Terence Ingham (to The English Electric Co., Ltd.). British Patent 835,410. May 18, 1960.

A design is offered of a contact for a fuel element which contacts a conducting wire in the fuel channel to transmit temperatures. Two independent sets of contacts are spaced axially on the fuel element, each set of contacts being connected with one lead of the thermocouple and being made up of several contacts angularly spaced around the fuel element. The other contact is two independent arc-shaped pieces embedded in the channel so that one of the fuel-element contacts touches it at all times. (T.R.H.)

14937

MASS SPECTROMETER. (to United Kingdom Atomic Energy Authority). British Patent 835,600. May 25, 1960.

A mass spectrometer design is offered which makes possible rapid U isotope abundance determinations with an unskilled operator. It has a thermionic positive ion source and a pair of flat positive focusing electrodes arranged at an angle to each other and spaced relative to the ion source so as to focus the positive ions into a beam directed to a collimator. The operation and design are described. (T.R.H.)

14938

IMPROVEMENTS IN OR RELATING TO WAVEGUIDE STRUCTURES. Richard Lewis Fortescue, George Brown Walker, and Nigel David West (to United Kingdom Atomic Energy Authority). British Patent 835,711. May 25, 1960.

A dielectric waveguide is described which has improved mode separation where the phase change per loaded section of the guide is π radians. The structure depends for its effect on the fact that at π mode there is a mode in the wall

current pattern along a line intersecting a plane through the centers of insulated disks normal to the axis of the guide. (T.R.H.)

14939

IMPROVEMENTS IN OR RELATING TO LIQUID-LIQUID CONTACTING APPARATUS. Rennie John Whalley Holt (to United Kingdom Atomic Energy Authority). British Patent 835,926. May 25, 1960.

A small, inexpensive mixer-settler with a large number of stages is described. A plastic block is drilled to provide settlers, and mixer tubes are placed concentrically in the settlers. At the bottom of each mixer tube is a sump for feeding the mixer and for flow between stages. (T.R.H.)

14940

ELECTRIC GRAPHITIZING FURNACES. (to Union Carbide Corp.). British Patent 835,953. May 25, 1960.

A large resistance-type furnace is described for graphitization and purification, in halogen-containing gases, of large carbonaceous bodies. The escape of noxious fumes is prevented. Vented distributor tubes introduce difluorodichloromethane upward through the carbonaceous bed which has been resistance-heated to 1700 or 1800°C. Gases leaving the top of the bed are led through ducts to a disposal system. (T.R.H.)

Materials Testing

14941 MIL-STD-271A (Ships)

Department of Defense, Washington, D. C.
MILITARY STANDARD NONDESTRUCTIVE REQUIREMENTS FOR METALS. Jan. 2, 1959. 30p.

A standard reference on the requirements for various test methods used in determining the presence of surface and internal discontinuities in metals is presented. Methods using techniques involving radiographic, magnetic particles, liquid penetrant, ultrasonic, and helium leak tests are defined. (J.R.D.)

14942 WADC-TR-59-400 (Pt. I)

STATISTICAL EVALUATION OF DATA FROM FATIGUE AND CREEP-RUPTURE TESTS. PART I. FUNDAMENTAL CONCEPTS AND GENERAL METHODS. Period covered: March 1, 1958 to February 28, 1959. Waloddi Weibull. Apr. 20, 1959. 78p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: FATIGUE AND CREEP OF MATERIALS. Contract AF61 (514)-1208. (PB-161297). OTS.

Fatigue tests are classified into three types with consideration to the appropriate method of evaluating the data. Fundamental statistical concepts, general methods, and useful tools are presented. The possibilities of estimating distribution parameters have been examined. Starting from the concept of information available in a sample, various methods of estimating the parameters of location, scale, and shape are discussed, completed by a comparison of the efficiency of various estimates. General principles of fitting curves to observations are outlined and applied to the methods of maximum likelihood, linear regression, and best linear estimators. (auth)

GEOLOGY, MINERALOGY, AND METEOROLOGY

14943 SC-3597 (TR)

Sandia Corp., Albuquerque, N. Mex.

AN APPROACH TO THE PROBLEM OF CIRRUS-CLOUD

FORECASTING. R. L. Hendrick. Feb. 24, 1955. 22p. OTS.

Physical theory and synoptic data regarding cirrus-cloud formation are examined. The synoptic parameters of the sign of the geostrophic advection of the 400- to 300-mb thickness on the 400-mb constant pressure surface and moisture reported in any amount above the 400-mb surface are selected as being related to the cirrus-formation process at the normal cirrus-cloud levels. The two parameters are combined to form a cirrus-indicator chart. The cirrus-indicator chart is shown to give reliable indication of existing cirrus and no-cirrus areas during the colder seasons over the western half of the United States, even though limitations exist. The cirrus-indicator chart is tested as a forecast aid and is shown to be of real, though limited, value. (auth)

14944 TID-5851

Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes.

STRUCTURE CHARACTERISTICS OF CLAY MINERALS AS INDICATED BY INFRARED SPECTROSCOPY. Technical Report No. VII. Theron L. Mackay, Milton E. Wadsworth, and Ivan B. Cutler. Nov. 1, 1954. 17p. Contract AT (49-1)-633. OTS.

The potassium iodide pellet technique was used to prepare mineral specimens for inspection of their oxygen-hydrogen stretching frequencies by infrared spectroscopy. The infrared absorption bands were observed to correspond with the positions of the hydroxyl groups in the structures of the clay and related minerals. Three absorption bands characterize the two layer clay and mineral group. One or two absorption bands have been observed among the three-layer clay minerals. The chlorite minerals and the chain type minerals also have spectra characteristic of their structures. (auth)

14945

CARBON-14 DATING IN PISA. G. Ferrara, M. Reinharz, and E. Tongiorgi (Università, Pisa, Italy). Am. J. Sci. Radiocarbon Suppl. 1, 103-10(1959).

Some information about the Nuclear Geology Laboratory in Pisa is given. The carbon-14 dating apparatus is described and results obtained on archeologic and geologic samples are given. (auth)

14946

USE OF LONG-LIVED NATURAL RADIOACTIVITY AS AN ATMOSPHERIC TRACER. W. M. Burton (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and N. G. Stewart (Dounreay Experimental Reactor Establishment, Caithness, Scotland). Nature 186, 584-9(1960) May 21.

The development of a radiochemical separation procedure has enabled a preliminary study to be made of the distribution of radium-D and radium-F in the atmosphere. Systematic results have been obtained which suggest that radium-D is a valuable natural tracer for the further study of atmospheric processes. (auth)

14947

THE DETERMINATION OF SILVER AND THALLIUM IN ROCKS BY NEUTRON-ACTIVATION ANALYSIS. D. F. C. Morris and R. A. Killick (Brunel Coll. of Tech., London). Talanta 4, 51-60(1960). (In English)

Neutron-activation analysis has been applied to the determination of silver and thallium in rocks. Samples of powdered rocks have been irradiated in the Harwell Pile BEPO. After irradiation, radiochemical separations using carrier chemistry have been based on precipitation, electrodeposition, and solvent extraction. Radiochemically pure silver and thallium have been finally precipitated and

counted as the iodate and chromate, respectively. Samples containing as little as 0.03 p.p.m. silver and 0.04 p.p.m. thallium have been analyzed. The rocks which have been examined include the two international standards G1 and W1 and also samples from the Insch Mass, Aberdeenshire, Scotland. (auth)

14548

ELECTRONIC INSTRUMENTS FOR DETECTING AND ASSAYING BERYLLIUM ORES. S. H. U. Bowie and K. C. Burke (Geological Survey of Great Britain, London) and H. Bisby and F. H. Hale (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Trans. Inst. Mining Met.* 69, 345-59(1959-60).

The detection of beryllium-bearing minerals in the field and the subsequent mining of ore are facilitated by the use of a portable electronic instrument, employing boron trifluoride counters, to measure the neutrons emitted when beryllium is bombarded by gamma radiation of suitable energy. Similar equipment for laboratory use enables accurate analyses of beryllium ores to be made without the need of costly and time-consuming chemical analyses. The portable gamma-neutron equipment is used in the field in much the same way as a Geiger-Mueller or scintillation counter is used in the search for uranium. Observed count rates can be related to percentage BeO in the surface layers of rock and assays made *in situ* with considerable accuracy and at the same time quickly and cheaply. The limit of detection for a counting time of 10 minutes with a 100 mc Sb^{124} source is about 5 ppm BeO. Possible interfering elements were considered in an appraisal of the laboratory apparatus and it is shown that, whereas corrections are required for differences in density of samples, only minor compensations are necessary where elements with a high neutron-capture cross section are present. The sensitivity of the laboratory gamma-neutron equipment depends on the source strength and counting time. In practice, the limit of detection is about 4 ppm BeO for a count of 10 minutes and 2 ppm for 60 minutes. (auth)

14949

URANIUM-BEARING FLUORITE DEPOSITS. Günter Zeschke (Z. UNESCO TAB, Lahore, Pakistan). *Z. Erzbergbau u. Metallhüttenw.* X, No. 7, 7p.(1957). (In German)

Uranium ore and fluorite are very important raw materials for atomic energy. The great need for these minerals has focused attention on places where they occur together. Geologically fluorite occurs in seams or breccia. Displacement and impregnation deposits are mostly interesting from a scientific viewpoint. All known and recently discovered occurrences of this type are in the USA, Turkey, and the German Federal Republic. Part of these have already been described. Violet fluorite has properties which make it valuable as a guide mineral for U prospecting. Economical production of U compounds from these occurrences has not been achieved, but the separation of U-bearing fluorite is possible. (T.R.H.)

HEALTH AND SAFETY

14950 A/AC.82/G/L.310

Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.

FALL-OUT EN LA REPÚBLICA ARGENTINA DURANTE 1959. (Fall-out in the Argentine Republic During 1959). N. Achard, D. Beninson, and A. Migliori. 1960. 10p.

In the Argentine Republic systematic measurements were made of the radioactivity of the surface air, precipi-

tation, and food materials. The results of the measurements of the surface air and of fall-out for the collection station at Buenos Aires are graphed. The accumulated fall-out of Sr^{90} from 1953 to the end of 1959 is also graphed. The concentration of Sr^{90} found in milk during the second half of 1959 is tabulated. (J.S.R.)

14951 A/AC.82/G/L.312

Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.

LA PRECIPITACIÓN RADIACTIVA ATMOSFÉRICA EN LA REPÚBLICA ARGENTINA EN EL PERÍODO ENERO 1957-JULIO 1958. (The Atmospheric Radioactive Fall-out in the Argentine Republic in the Period from January 1957 to July 1958). Carlos A. Henkel, Nicolás Nussis, and Marcos Menis. 1959. 9p.

The results obtained in the measurement of the radioactive fall-out in Argentina are tabulated. The total beta activity, the Sr^{90} activity, the total accumulative beta activity, and the values of n corresponding to the exponent of t in the expression $A_t = A \times t^{-n}$ for each monthly measurement are presented in the table. The tabulated values are also graphed. (J.S.R.)

14952 A/AC.82/G/L.330

Akademiia Nauk S.S.S.R.

VYPADENIE STRONTSIA-90 NA POVERKHNOST' TERRITORII SSSR. (Fall-out of Sr^{90} in USSR). V. M. Shubko. 1959. 8p.

Results of the average yearly Sr^{90} fall-out obtained by radiochemical analysis of the ash from a gauze filter were in good agreement with results obtained by other methods. The fall-out for 1958 was estimated to be twice that of 1957; for the months between March and November it was $3.8 \mu\text{c}/\text{km}^2$. (R.V.J.)

14953 AERE-R-2954

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

ENVIRONMENTAL SURVEY FROM THE AIR. D. Williams and R. S. Cambray. Feb. 1960. 41p. BIS.

A method of aerial environmental survey is described and the results of an experimental survey of the Harwell area analyzed. An evaluation is made of the capabilities of the technique with particular reference to the detection of small concentrations of deposited I^{131} . Consideration is given to the problems of aerial survey and the practical limitations are discussed. (auth)

14954 AERE-R-3299

United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England; Oxford Univ.; and Gt. Brit. Medical Research Council. Radiobiological Research Unit, Harwell, Berks, England. STRONTIUM-90 IN HUMAN BONE IN THE U.K., 1956-1958. N. T. J. Bailey, F. J. Bryant, and J. F. Loutit. Mar. 1960. 42p. BIS.

A simplified account is presented of the role of calcium and strontium in the body and of the determination of radiostrontium in bone together with an appraisal of the results for the years 1956 to 1958 inclusive. (auth)

14955 CEX-59.13

Oak Ridge National Lab., Tenn.

EXPERIMENTAL EVALUATION OF THE RADIATION PROTECTION AFFORDED BY TYPICAL OAK RIDGE HOMES AGAINST DISTRIBUTED SOURCES. T. D. Strickler and J. A. Auxier. Jan. 1960. 51p. OTS.

The protection afforded against simulated fall-out radiation has been evaluated for several typical homes in the Oak Ridge area. Nine houses were chosen to represent a

variety of construction materials, topographical conditions, and sizes; they included three types of Oak Ridge Cimento houses, one concrete-block house with a basement fall-out shelter, and two wood-frame houses. The protection factor (ratio of open-field exposure dose rate to exposure dose rate in the house) in all these houses ranged from 2 to 5 on the main floor and from 5 to 30 in the basements, except in the fall-out shelter, where the protection factor was greater than 100. The analysis showed that sloping lots, common to Oak Ridge, do not appreciably affect the protection factor for the main floor. Owing to the generally increased exposure of the basement walls on such lots, the protection factors in the basements were typically lower than in similar basements built on level lots. (auth)

14956 ITR-1449

Ammann and Whitney, New York.

RESPONSE OF DUAL-PURPOSE REINFORCED-

CONCRETE MASS SHELTER. E. Cohen and E. Laing.

Sept. 1957. 54p. Project 30.2 [of] OPERATION PLUMB-BOB.

A typical full-scale section of a prototype reinforced concrete dual-purpose underground parking garage and personnel shelter was tested at the predicted 35-psi peak overpressure level of a nuclear blast. The primary purpose was to evaluate the capabilities of the structure in providing protection against effects of a nuclear detonation. Secondary objectives were to obtain additional information regarding blast load transmitted to underground structures, information regarding reflected and dynamic pressures in the ramp and on the entranceway door, data on nuclear radiation attenuation characteristics of the structure, and design features. Results are described and illustrated photographically. (C.H.)

14957 KAPL-M-HP-4

Knolls Atomic Power Lab., Schenectady, N. Y.

HEALTH PHYSICS QUARTERLY REPORT [FOR]

JANUARY-MARCH 1960. R. J. Feinberg, comp. 22p.

Contract W-31-109-Eng-52. OTS.

Routine health physics activities for the period are summarized. (C.H.)

14958 NP-8695

Cornell Univ., Ithaca, N. Y. Coll. of Architecture.

THE SCHOHARIE VALLEY TOWNSITE—A PROTECTED COMMUNITY FOR THE NUCLEAR AGE. Jan. 1960. 64p.

A community and industrial installation was designed which can maintain its operations during and after a nuclear explosion. A two-week self-sustaining post-explosion refuge period was assumed. A town of nine thousand population was assumed. Government, communications systems, transportation systems, and the shelter system are described. All facilities are illustrated with schematic sketches. (C.H.)

14959 NSEC-22

Nuclear Science and Engineering Corp., Pittsburgh.

EVALUATION OF RADIOACTIVE FALLOUT. Interim

Progress Report. Leonard P. Salter. Feb. 1, 1960. 46p.

Contract AT(30-1)-2420. OTS.

Preliminary results are reported for the first test in correlating meteorological phenomena with the variations of fall-out in consecutive intervals during a precipitation period. The concentrations, and ratio of Sr-90 and Ce-144 in the stratosphere, ground level air and precipitation are being studied as a means of dating nuclear debris and detecting fractionation of radioactive constituents. (auth)

14960 NYO-4811

Harvard Univ., Boston. Air Cleaning Lab.

FIBROUS FILTERS FOR NaK FUME REMOVAL. Richard

Dennis, Edward Kristal, and Leslie Silverman. May 1, 1960. 40p. Contract AT(30-1)-841. OTS.

Accidental release of Na or NaK coolant from liquid loops may lead to rapid burning of the metal and dense fume production. Corrosive properties of the fume require that it be removed from operating areas by ventilation and washing of equipment. Restrictions on the quantity discharged to atmosphere require about 90% retention by fume collection devices to prevent damage to metal surfaces and vegetation. Studies with several bulk fiber collectors (glass, Saran, Dynel) indicate that relatively deep beds of fibers (2 to 6 inches) in the 10 to 50 micron diameter range are the most practical choice to meet specific cleaning requirements of 90% collection efficiency, resistance not to exceed 15 in. of water, holding capacity of 0.5 lb NaK hydroxides per 1000 cu ft per min filtration capacity, fire retardant, and corrosion resistant. Experimental filters composed of bonded Dynel fibers met the above specifications in both laboratory and field tests except for that of filtration capacity (700 rather than the desired 1000 cu ft per min for a filter unit 2 ft x 2 ft in face area). Tests indicated that finer fibers or graded fiber beds might offer improved performance. Comparative cost and performance data are shown for Dynel filters and other commercial collectors, wet scrubbers, and electrostatic precipitators. (C.H.)

14961 SCTM-195-59(51)

Sandia Corp., Albuquerque, N. Mex.

FALLOUT CONTOURS AT ALBUQUERQUE, NEW MEXICO.

D. A. Young. Jan. 1960. 78p. OTS.

Fall-out contours are presented which were computed from a shear wind model. The program used to compute these contours is described in SCTM 194-59(51). The winds used in the program were taken over a 5-year period from March 1, 1953, to February 28, 1958, at Albuquerque, New Mexico. (auth)

14962 TID-5748

Hawaii. Univ., Honolulu. Marine Biology Lab.

A STUDY OF THE POSSIBLE RELATIONSHIP BETWEEN RADIOACTIVITY AND TOXICITY IN FISHES FROM THE CENTRAL PACIFIC. Philip Helfrich. May 1960. 17p. Contract AT(04-3)-235. OTS.

Accumulated data show an absence of any correlation between radioactivity (gross beta and gamma activity) and *Ciguatera*-type toxicity in samples of muscle, liver, and gonads from lutjanid fishes from the Marshall and Line Islands. In a high per cent of the samples tested, the liver was more radioactive than the gonads and muscle. Only rarely was the muscle more active than the gonads and/or liver. The mean half life of thirty-five beta activity samples was calculated to be 222 days. No consistency was observed in the rate of decay of samples in regard to the tissue involved, the species of fish, or the geographical area from which the fish was obtained. Comparison of the results of previous surveys and the beta half life of samples analyzed in this investigation suggest Zn^{65} and possibly Co^{57} are probable constituents of the samples analyzed. Absence of any correlation between *Ciguatera*-type toxicity and radioactivity in fishes of the Central Pacific is reasonable in the light of the history of fish poisoning which antedates all nuclear detonations, the distinct syndromes in radiation sickness and fish poisoning, and the complete absence of toxicity in groups of fishes known to have been radioactive. (auth)

14963 TID-5794

Atlantic Research Corp., Alexandria, Va.

SAMPLING THE UPPER ATMOSPHERE FOR PARTICULATE MATTER. Second and Third Quarterly Progress

Reports, September 25, 1959 to March 25, 1960. Michael Markels, Jr. and Harold E. Bishop. Apr. 1960. 39p. Contract AT(30-1)-2404. OTS.

Various methods for collecting particulate matter in the upper atmosphere using a rocket vehicle are analyzed. A descending rotorchute which depends on rotating blades for controlling descent velocity and for supporting sampling apparatus is described. Equations, sample calculations, and sketches show complete design and theoretical performance. A theoretical investigation showed that a descending rotorchute with five rotating blades, each 14 feet long and containing five impactors per blade for sample collection, can sample over 2,000 std cu ft of air in descending from 200,000 to 100,000 feet. It can remove particles as small as 0.01 micron with a calculated efficiency of 80% or better. A variable rotor tip speed during descent can be used should the extra convenience and ease of interpretation provided by equal sampling per unit mass of air be desired. The calculated sample sizes obtained by rotorchute are ten times as great as for any other system studied to date. The 40 pound payload including rotor blades, impactors, hub, controllers, and telemetering equipment can be sent to 200,000 feet by an Arcon rocket for an estimated cost of 6,000 to \$8,000 per flight for the purchased items. (For preceding period see AECU-4626.) (auth)

14964 TID-5847

Western Precipitation Corp., Los Angeles.

A CONCEPTUAL STUDY OF POSSIBLE COLLECTING SYSTEMS FOR USE IN STRATOSPHERIC SAMPLING. Apr. 25, 1959. 91p. Contract AT(04-3)-234. OTS.

Because the use of filters to sample particulate matter suspended in the upper atmosphere has been investigated and has yielded rather disappointing results, an examination of other methods of upper atmospheric sampling is desirable, and this is the aim of the present study. The nature of any radioactive material and its relation to the size and composition of the suspended particles are of particular interest. Among the methods considered are those based on electrical, mechanical, and thermal separation processes, under conditions of relatively long molecular mean-free-path in the suspending air. With reasonable restrictions of weight and time of collection, success may be expected using sufficiently refined designs based on each of these methods. Certain advantages and disadvantages are associated with each, as might be expected, but the greatest possibility of success appears to be offered by a centrifuge designed carefully to maintain laminar flow. (auth)

14965 USNRDL-TR-336

Naval Radiological Defense Lab., San Francisco.

STONEMAN II TEST OF RECLAMATION PERFORMANCE. VOLUME III. PERFORMANCE CHARACTERISTICS OF DRY DECONTAMINATION PROCEDURES. H. Lee, J. D. Sartor, and W. H. Van Horn. June 6, 1959. 104p.

The basic decontamination procedures such as firehosing, motorized flushing, and scrubbing evaluated during the field test conducted at Camp Stoneman in 1956 required the use of large quantities of water. Since it was recognized that in many situations adequate water supplies will not be available for use in large scale decontamination operations, and under emergency conditions water systems may be damaged or otherwise depleted, it appeared desirable to develop and/or exploit decontamination methods that do not require the use of water. A series of tests was therefore conducted to develop and evaluate new reclamation techniques for land targets with emphasis on waterless decon-

tamination methods. The tests conducted were limited to the evaluation on asphaltic concrete and portland cement concrete. Using synthetic fall-out to simulate dry fall-out from nuclear weapons detonated on a land surface, effectiveness and rate of removal data were obtained for the evaluation of three procedures for waterless decontamination of large paved areas, namely motorized sweeping, vacuumized sweeping, and air broom sweeping. The highest degree of effectiveness was obtained with the air broom and the highest rate of removal was obtained with motorized sweeping using the Wayne 450. However, the removal of heavy deposits by the air broom produces a large dust cloud and the procedure could probably be used only when the situation is such that contamination of downwind areas can be tolerated. A mathematical model, based upon theoretical considerations, has been developed for the comparative evaluation of decontamination methods. Using this model it is possible to accurately evaluate dry decontamination methods and to predict the effect of various environmental parameters. (auth)

14966 USNRDL-TR-418

Naval Radiological Defense Lab., San Francisco.

PRELIMINARY REPORT ON THE SHELTER OCCUPANCY TEST OF 3-17 DECEMBER 1959. W. E. Strobe, H. S. Etter, R. A. Goldbeck, R. H. Heiskell, and J. H. Sheard. May 4, 1960. 91p.

The USNRDL experimental shelter at Camp Parks, California, was occupied continually for a period of 2 weeks by 100 male volunteers. During this period, all aspects of the shelter environment were monitored as well as the actions and responses of the shelterers. Shelter facilities were tested, the effectiveness of a proposed shelter organization and procedures were evaluated, and the palatability and preparation procedures of several food rations were evaluated. This is a preliminary report made in advance of complete analysis of the data. (auth)

14967 WT-1507

Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

THE INTERNAL ENVIRONMENT OF UNDERGROUND STRUCTURES SUBJECTED TO NUCLEAR BLAST. II. EFFECTS ON MICE LOCATED IN HEAVY CONCRETE SHELTERS. D. R. Richmond, C. S. White, R. T. Sanchez, and F. Shering. Sept. 1959. 24p. Project 33.6 [of] OPERATION PLUMBBOB. OTS.

A cage containing 20 mice was placed in each of 12 underground shelters in an attempt to assess biologically the inside environment of the shelters. Two samples of 20 mice each acted as controls. The structures, of French and German design, were located at ranges between 840 ft and 4320 ft from Ground Zero. A nuclear device was exploded atop a 700-ft tower and had a yield of 43 kt. All but one group of mice were recovered on D + 2 days. Aside from two samples placed in unrealistic locations, all animals were alive at recovery. With one exception, the peak pressures in the chambers that contained mice were insignificant, ranging from a fraction of 1 psi to 1.6 psi. The one high pressure of 14.4 psi did not kill any of the mice. According to the film-badge dosimeters, one group of mice received 190 r of gamma radiation. The others were exposed to 54 r of gamma or less. The mice were observed for a 60-day postshot period. The deaths that occurred were attributed to a Salmonella infection in the animal colony and not to radiation. Although the gamma radiation doses that most of the animal groups received were low, the levels that existed in the main chambers near the entry doors of the German shelters were over 100 r, a biolog-

ically significant dose. In contrast, the environment within two of the French shelters appeared to be quite acceptable. (auth)

14968 JPRS-L-820-N

SIGNS OF CERTAIN FUNCTIONAL DEVIATIONS FOUND IN WORKERS OF ROENTGEN INSTITUTIONS. A. A. Bagdasarov, P. M. Al'perin, E. (Ye.) V. Kasatkin, and R. I. Rodina. Translated from *Klin. Med. (U.S.S.R.)* 37, No. 4, 19-25(1959). 12p. OTS.

Results are reported from a survey of the blood picture in 62 physicians, 68 x-ray technicians, and 40 orderlies who had worked in x-ray offices in the USSR for various periods of time. Changes in blood picture attributed to radiation were found in 74 of the persons examined. Data are tabulated. Symptomatology is described and the quality of protective measures is discussed briefly. (C.H.)

14969

ON THE ADEQUACY OF HALF-VALUE LAYER AS A CRITERION OF X-RAY QUALITY IN THE CALIBRATION OF DOSEMETERS. N. M. Procter and J. R. Greening (Edinburgh Univ. and South Eastern Regional Hospital Board, Scotland). *Brit. J. Radiol.* 33, 321-5(1960) May.

Five thimble ionization chambers were compared with a free-air chamber using x rays produced at 20 to 55 kv with half-value layers between 0.05 and 0.20 mm Al. One chamber showed a difference of nearly 4 per cent in its correction factor for beams of the same HVL produced at 20 and 55 kv. With this single exception HVL appeared to be an adequate criterion of x-ray quality for the calibration of ionization chambers. (auth)

14970

EXPERIENCE IN CONNECTION WITH THE REMOVAL OF RADIOACTIVE SOLUTION FROM THE EYE. Sandor Gyorgyi (Medical Physics Inst.). *Energia és Atomtech.* 12, 278-9(1959) May-June. (In Hungarian)

A laboratory accident is reported in which an aqueous solution of Na_2HPO_4 containing P^{32} , got into the patient's eye. The specific activity of the solution was 600 $\mu\text{C}/\text{ml}$. Rinsing with tap water for several minutes following the accident removed what was estimated as a major portion of the activity. An appreciable amount of activity still remained and could not be removed either with boron solutions or by mechanical means. Activity was measured with a GK-4 type portable G-M counter. The count dropped to 25% when the eyelid was shut, an indication that not only the surface of the eyeball but its interior was also contaminated. The effective half life was approximately equal to 4 days. Consequently, at a radioactive half-life of 14.3 days, the biological half life was about 5.5 days. When the eye was irritated, the mucus from the nose contained a small but detectable amount of activity. This led to the assumption that with tear-exciting media the biological and effective half lives could have been shortened. Comparison tests with the same G-M counter showed that the activity of the P^{32} in the eye was 0.02 μC . The total dose was computed to equal approximately 1.1 rep. In view of the fact that the interior of the eyeball was also contaminated, the actual dose can be estimated one order of magnitude higher. Several months have elapsed since the accident, but no permanent damage to the eye has been reported. Laboratory tests with animals showed that, through ion exchange, washing the eye with inactive phosphate solutions instead of tap water speeds up the elimination of the radioactive substance. In the first days elimination was 50 to 60% faster than in the control groups. (JPRS)

14971

SOME PROBLEMS REGARDING PERMISSIBLE DOSES

WITH RADIOACTIVE ISOTOPES. Edith H. Quimby (Columbia Univ., New York). *J. Nuclear Med.* 1, 14-22(1960) Jan.

It is pointed out that for any particular situation it is necessary to weigh the expected good against the feared harm and come to a decision. This is also true of radiation risk. There is no doubt that x rays and radioactive materials have made marked contributions to our health and well-being and it would be unthinkable for medicine to dispense with them. It is true that their use carries its quota of hazards for some individuals and in comparison with the gains the risks are difficult to evaluate on a cause and effect basis. Permissible radiation dose levels have been set for radiation workers and for the general population. Permissible doses with radioactive isotopes are discussed. (C.H.)

14972

FALLOUT—ONE OF SEVERAL SOURCES OF RADIATION EXPOSURE TO THE TOTAL POPULATION. Charles L. Dunham (U. S. Atomic Energy Commission, Washington, D. C.). *J. Nuclear Med.* 1, 50-5(1960) Jan.

The biological consequences of radioactive fall-out from nuclear weapons tests are discussed. It is pointed out that actual data are practically non-existent on the effects in humans of radiation exposures involving the low total doses and low dose rates associated with present levels of fall-out. Any exposure to radiation may be assumed to involve some degree of risk and is therefore undesirable unless there is adequate reason for the exposure. Standards for the evaluation of risk from fall-out are discussed. (C.H.)

14973

DEPTH DETERMINATION OF RADIOACTIVITY WITH BIDIRECTIONAL COLLIMATION. H. F. Hurd and Earl Featherstone (Brooke Army Medical Center, Ft. Sam Houston, Tex.). *J. Nuclear Med.* 1, 56-8(1960) Jan.

A method of triangulation has been applied to the occasional problem of depth determination of a gamma source, by means of a bidirectional collimator for use on a scintiscanner. The principles and advantages of this approach are discussed. Other possible uses are suggested. (auth)

14974

STUDY ON THE SPATIAL DISTRIBUTION OF THE DOSE IN THE IRRADIATION OF MICE AND RATS WITH 150 kVm X-RAYS, WITH Co^{60} GAMMA RAYS AND WITH 15 Mev ELECTRONS. P. G. Paleani Vettori and C. Biagini (Università, Rome). *Nuntius Radiol.* 25, 654-63(1959) June. (In Italian)

Distribution of the dose of 150 kVm x-rays, Co^{60} gamma rays, and 15 Mev electrons in phantoms of rat and mouse was investigated in different experimental conditions. The possible influence of dose dishomogenities on the results of biological experiments and the possibility of improving the conditions of irradiation are discussed. (auth)

14975

RESEARCH ON THE FACTORS INFLUENCING DOSIMETRY OF HIGH ENERGY ELECTRONS PRODUCED BY THE BETATRON. C. Biagini, C. Bompiani, and P. G. Paleani Vettori (Università, Rome). *Nuntius Radiol.* 25, 698-705 (1959) July. (In Italian)

Some possibilities of errors in the dosimetry of high-energy electrons are examined. As to the electrons accelerated by the betatron, the necessity is stressed of keeping the beam intensity as constant as possible, in order to avoid the errors due to oversaturation of the ionization chambers. The possibilities of error connected with temperature changes and radioactivity produced within the

chambers or in their proximity by phenomena of electro-disintegration of the nuclei are also discussed. (auth)

14976

RADIOACTIVE FALLOUT. WHAT'S BEING DONE ABOUT IT. PART II. HOW SOILS ARE DECONTAMINATED.

Paul R. James and Ronald G. Menzel (U. S. Dept. of Agriculture, Beltsville, Md.). Plant Food Rev. 5, No. 5-7, 32-3(1959).

Results are reported from a series of tests to find effective methods of removing radioactive fall-out from farm lands. Types of vegetation tested included pasture sod, young soybeans, young sudangrass, and areas covered with various amounts of straw mulch. Six methods of decontamination were repeated in triplicate on each type of cultivation. These included one cut of a grader, two cuts of a grader, and asphalt spray application followed by one pass of the grader. Rolling preceded the spray application on three rolled plots. Results are presented graphically. (C.H.)

14977

CHEMICAL DOSIMETRY OF ISOTOPES USED THERAPEUTICALLY. Dieter Hofmann and Carl Friedrich Michel (Universitäts-Frauenklinik, Giessen, Ger.). Strahlentherapie 112, 54-62(1960) May. (In German)

Dithiozone, dissolved in chloroform, is a radiosensitive system, which is very suitable for the determination of small doses. It is particularly suitable for the dose determination of radiation of short range, as demonstrated for radiogold and strontium-90. The properties of the solution permit direct contact of the solution with colloidal radiogold, avoiding the disadvantageous effect of other media. The determination of G- and M-values is up to now not possible, because the measured changes do not quite conform with the true values. The comparison of the radiation induced chemical turnover with dose determinations by means of the air ionization chamber is only conditionally possible, due to the different conditions for absorption. For the same reason it can not be decided whether there is and to what extent there is a true dependence of the energy at the voltage measured. The question of dependence of the energy and its definition is discussed. A comparison of different qualities of radiation according to these results is possible, if there is complete absorption of each dose, that is to say, the layer thickness must be sufficient. (auth)

14978

FEASIBILITY OF RADIATION PROTECTION IN THERAPEUTIC GYNECOLOGICAL RADIUM IRRADIATION.

H. Zeitz and H. Zolg (Universitäts-Frauenklinik Heidelberg, Ger.). Strahlentherapie 112, 114-23(1960) May. (In German)

A great number of isodose determinations at the University GYN. Hospital Heidelberg were performed in the rooms of patients who received radium treatment. The best protection is given for the nursing staff if the patients with radium are placed with their feet towards the wall, if possible towards an outer wall or at least towards a wall whose adjacent room is little used. Other patients in the same room should be placed towards the head of the patient with radium. A total dose of 0.2 r was found per patient with radium treatment per week for the entire nursing care. Therefore one nurse should care only for one patient who has a radium application. (auth)

14979

RESEARCH ON GONAD DOSE IN WOMEN FROM X-RAY DIAGNOSTICS. Alfons Rummel (Universitäts-Frauenklinik Würzburg, Ger.). Strahlentherapie 112, 124-32(1960) May. (In German)

Based on experiments performed with the condrometer, x-ray examinations for pregnancy, hystero-salpingography, irrigoscopy, and pyelography the surface dose, depth dose and exit dose was measured. The values found were supplemented by phantom studies particularly concerning the dependence of the gonad dose from voltage, amperage and field size. Because every radiation injury is significant for the germ cells and even minimum doses applied at different times are cumulative, the benefit of an x-ray examination must be correlated with the risk of possible gene damage. The probability of a gene damage by a low exposure is not great, but it may even be possible with a minimum quantity of radiation. Therefore the benefit and risk must be carefully considered. X-ray examinations, mainly concerning the female pelvic organs, should be limited to the most necessary cases. The high responsibility for the present and future generations of all physicians doing x-ray work is pointed out. (auth)

14980

APPARATUS FOR THE AUTOMATIC WARNING OF SUPERNORMAL RADIOACTIVE RADIATION. (to Landis & Gyr AG). German Patent DAS 1 053 107. Mar. 19, 1959. Kerntechnik 2, 148(1960) Apr. (In German)

It was proposed to use as indicator for the detection of radioactive substances an ionization chamber which during the largest part of each measurement period remains separated from the monitoring apparatus and only during a small fraction of each period is automatically connected to the alarm system. The apparatus consists of an ionization chamber working on an amplifier tube and serving as an indicator. The isolated electrode of the ionization chamber is connected by a highly insulating permanent compound condenser with the grid of an amplifier tube and is connected periodically for a short time by a single pole switch to ground. The radiation arising in nuclear processes consists of α , β , and γ radiation and fast and slow neutrons. It is not possible to construct an ionization chamber equally sensitive to each type of radiation. It is possible to use several ionization chambers in connection with the periodic switch so that one chamber can be sensitive to α radiation and another to β radiation, etc. In this manner one monitoring system could be used for all types of radiation.

14981

RADIOACTIVE MATERIALS IN THE LABORATORY. Gudbrand Jenssen. Tek. Ukeblad 106, No. 2, 6p.(1959). (In Norwegian)

The basic rules for work with radioactive materials in the laboratory are given. Some of the methods for decontamination of skin and equipment are outlined. (auth)

14982

REPORT OF THE COMMITTEE ON TRAINING IN [RADIOLOGICAL] HEALTH & SAFETY TO THE AUTHORITY COMMITTEE ON HEALTH AND SAFETY, UNITED KINGDOM ATOMIC ENERGY AUTHORITY, FEBRUARY 1960. London, Her Majesty's Stationery Office, 1960. 101p. 5s. 6d.

Proposals are outlined for a National radiological advisory service in the United Kingdom. The demands for trained persons in the field of radiological health, the classification of workers, and training required are discussed. (C.H.)

14983

Public Health Service, Washington, D. C. RADIOLOGICAL HEALTH DATA MONTHLY REPORT. APRIL 1960. 54p. \$0.50(OTS).

Maximum permissible radiation dose measurements are

reviewed and the criteria used in establishing the levels are discussed. The U. S. Public Health Service Milk Monitoring Network, consisting of 12 sampling stations, will be expanded to about 60 stations by the summer of 1960. Data are summarized on strontium-90 and calcium in milk samples collected during 1958 and 1959. The Public Health Service Radiation Surveillance Network was established in 1956 and air samplers are in operation at 44 stations. Measurements are made of gross beta radioactivity of the air and the filters are then forwarded to the Washington laboratory for more refined measurements. About 85% of the stations also collect samples of precipitation which are sent to the Washington laboratory for analysis. Data are tabulated on fission product β -activity in air samples collected during November, 1959. The National Water Quality Network has operated in cooperation with State and local health agencies since October, 1957. At present 61 sampling stations are located on major waterways used for public water supply and other public uses. Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Gross alpha and beta measurements are made on both suspended and dissolved solids in the raw surface water samples. Data during 1957, 1958, and 1959 are tabulated. Miscellaneous activities of the Radiation Surveillance Network are also summarized. (C.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

14984 AI-1635

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.
LOGISTIC AND ECONOMIC FEASIBILITY STUDY ON RADIATION STERILIZATION OF FOODS. Report No. 4 (Progress). Phase III. R. J. Beeley. May 24, 1956. 26p. Project 7-84-01-002. Contract DA-19-129-qm-491.

In this report are presented layouts, performance data, and partial cost estimates for radiation facilities using spent fuel elements or sodium-24. Preliminary material on facilities using an electron accelerator, gaseous fission products, and separated Cs-137 is presented. A facility which includes a reactor designed expressly for the purpose of activating a material such as manganese or indium is discussed. (auth)

14985 NP-8657

Australia. Commonwealth X-Ray and Radium Lab., Melbourne.

IONIZING RADIATIONS IN INDUSTRY AND SANITARY ENGINEERING: APPLICATIONS—TECHNIQUES—SAFEGUARDS. Library Information Bulletin No. 49. Jan. 1960. 10p.

A subject index of selected literature on applications, techniques, and safeguards for ionizing radiations in industry and sanitary engineering is given. (J.R.D.)

14986 TID-5869

Radiation Applications Inc., New York.

THE TECHNOLOGY AND APPLICATIONS OF LARGE FISSION PRODUCT BETA SOURCES. Quarterly Report for Period Ending March 31, 1960. 16p. Contract AT(30-1)-2186. OTS.

Strontium-containing enamels with improved acid resistance were prepared. The problem of excessive foaming of cerium-containing enamels during initial melting has been eliminated by the addition of Na_2SO_4 to these formu-

lations. Dosimetry for Ce^{144} sources containing less than $1 \mu\text{c}$ per square inch is presented. A dose-rate study for methacrylic acid-styrene graft system on polypropylene shows good reproducibility, good processing behavior of the commoner system, and excellent dyeing characteristics. An engineering design of a pilot-scale, graft copolymerization, beta irradiator is in progress. (auth)

14987 TID-8521

Office of Operations Analysis and Forecasting, AEC.
POSSIBLE LARGE-SCALE USES OF SEPARATED FISSION PRODUCTS. Presented at the November 1959 Meeting of the Atomic Industrial Forum. Apr. 1960. 7p. OTS.

The current status of possible large-scale uses of separated fission products is reviewed. A brief discussion of applications which may lead to large-scale utilization is presented. Problems which must be considered in evaluating these uses, specific fission products of interest, and the magnitude of the quantities involved are discussed. (J.R.D.)

14988

TECHNOLOGICAL PRINCIPLES FOR DESIGNING GAMMA-ACTIVE ISOTOPE APPLICATORS. Laszlo Tihanyi (Highway and Railroad Planning Enterprise). Energia és Atomtech. 12, 492-8(1959) July-Aug. (In Hungarian)

Some examples of the uses of gamma-active sources of 10,000 c or more are cited, and a general outline is given for selecting the sources required, the geometry of radiation (self-absorption, collimators, etc.), and the principles to be observed in designing irradiation chambers (floor plans, storage, shielding, remote control, instrumentation, interlocking, optics, and monitoring). Of the three references in the bibliography two are English-language and one is German-language. An irradiation chamber in which the source, when not in use, is stored in an underground bomb-proof compartment capable of withstanding a direct hit by a one-ton conventional bomb is described. An irradiation chamber of this type has been in operation for more than three years. (JPRS)

14989

MATERIALS TESTING WITH RADIOACTIVE ISOTOPES. VDI Zeitschrift 102, 424(1960) Apr. 11. (In German)

Labeled substances are used for density-wear tests, in metallography, in corrosion research, and in analytical chemistry. By measurement of the adsorption and scattering of nuclear radiation in and on the material, the surface weights and compositions can be determined. These methods have been employed in automatic production processes. (tr-auth)

ISOTOPE SEPARATION

14990 LS-67

Israel. Atomic Energy Commission, Tel Aviv.
LITERATURE SURVEY ON MASS SEPARATORS. Aug. 1959. 22p.

A bibliography is presented on mass spectrometers and electromagnetic isotope separators. The references are taken from Nuclear Science Abstracts 1948 through issue No. 11, 1959, Chemical Abstracts 1948 through issue No. 11, 1959, Nucleonics 1959 (Nos. 1-7), and Bibliographies of Interest to the AEC. 236 references. (T.R.H.)

14991 AEC-tr-4078

THE SEPARATION TUBE. XIX. FOR THE ENRICHMENT

OF THE Br^{79} AND Br^{81} ISOTOPES. Klaus Clusius and Hans-Ulrich Hostettler. Translated for (Oak Ridge National Lab.) from *Z. Naturforsch.* **12a**, 974-82(1957). 36p. (Includes original, 8p.). JCL.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 5490.

14992 JPRS-2499

THE PRODUCTION OF DEUTERIUM OXIDE AND THE DETERMINATION OF ITS DENSITY. A. I. Shatenshteyn, L. M. Yakimenko, V. R. Kalinachenko, and Ye. A. Yakovleva. Translated from *Zhur. Neorg. Khim.* **2**, 985-94(1957). 17p. OTS.

An apparatus for the production of deuterium oxide was constructed and deuterium oxide of high isotopic purity was prepared. The density of deuterium oxide was measured at temperatures of 25, 30, 40, and 50°C. (C.J.G.)

14993 JPRS-2527

THE SEPARATION OF STABLE NITROGEN ISOTOPES BY THE CHEMICAL EXCHANGE METHOD. [PART] II. G. M. Panchenkov, I. A. Semiokhin, and O. P. Kalashnikov. Translated from *Zhur. Fiz. Khim.* **31**, 2224-8(1957). 10p. OTS.

The relations between the separation of isotopes of nitrogen, the rate of flow of reagents, and the temperature in a separation column with a packing under the conditions of counterflow were investigated. It was shown that the time for reaching a stationary state diminishes with the increase on the rate of flow and temperature. Other conclusions on the optimum rate of input and on the common coefficient of separation were also reached. (J.R.D.)

14994 JPRS-2528

THE CONCENTRATION OF THE HEAVY ISOTOPES OF CARBON BY A CHEMICAL METHOD. Yu. K. Shaposhnikov. Translated from *Zhur. Fiz. Khim.* **32**, 869-74(1958). 12p. OTS.

A method of concentrating and separating the heavy isotopes of carbon by isotope exchange in a solution of monoethanolamine bicarbonate is described. The effects of working solution concentration, exchange column temperature, working solution feed rate, shape of packing, and quantities of the carbonic anhydride ferment catalyzer on the separation ability of the column were studied. (C.J.G.)

14995 NP-tr-417

PRODUCTION OF HEAVY HYDROGEN IN A LARGE-SCALE RECTIFICATION PLANT. W. Lehmer, A. Sellmaier, and W. Baldus. Translated by L. H. Sinclair (U.K.A.E.A. Atomic Energy Research Establishment) from *Linde Ber. Tech. u. Wiss.* **5**, 3-14(1959). 31p. JCL.

The construction and operation of a hydrogen-isotope separation plant are described. Deuterium separation is effected by rectification of hydrogen in gases which may include impurities. (J.R.D.)

14996

PROCESS FOR OBTAINING HYDROGEN HAVING AN INCREASED DEUTERIUM CONTENT. Erwin Willy Albert Becker. British Patent 834,306. May 4, 1960.

An improvement or modification of the O enrichment process of patent No. 803,274 (*NSA* Vol. 13, No. 16026) is described. The yield of D is increased by having the depleted H_2 from the cold column further reduced in D_2 content by flowing through an additional cold column. The further-depleted H_2 can be used chemically or reconstituted to normal D_2 content in a hot column exchange with water. The extra hot and cold columns are referred to as the stripping system. (T.R.H.)

14997

METHOD FOR THE ENRICHMENT OF HEAVY WATER. E. Justi (to Ruhrchemie AG and Steinkohlen-Elektrizität AG). German Patent DAS 1 051 820. Mar. 5, 1959. *Kern-technik* **2**, 148(1960) Apr. (In German)

A method for the enrichment of heavy water by the stepwise electrolysis during combustion of the gases produced in one cell and restoration of the water so formed in the next cell is described. The combustion is carried out on an oxyhydrogen gas and the electrical energy obtained from it is applied to the water electrolysis.

MATHEMATICS AND COMPUTERS

14998 NP-8687

Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas. ALGUNS RESULTADOS RECENTES SOBRE EQUAÇÕES DIFFERENCIAIS PARCIAIS LINEARES DE COEFICIENTES CONSTANTES. (Some Recent Results on Partial Differential Linear Equations with Constant Coefficients). Leopoldo Nachbin. 1959. 9p. (Notas de Física Vol. V, No. 16).

A method of solving partial differential linear equations with constant coefficients is given and discussed. (T.R.H.)

14999 ORNL-2915

Oak Ridge National Lab., Tenn. MATHEMATICS PANEL PROGRESS REPORT FOR PERIOD SEPTEMBER 1, 1958 TO DECEMBER 31, 1959. Apr. 28, 1960. Contract W-7405-eng-26. OTS.

Operation and programming of ORACLE are described, and current research problems are briefly summarized in numerical analysis, biology and medicine, health physics, metallurgy, reactors, physics, and chemistry. Training programs, seminars, lectures, and publications are listed for the report period. (For preceding period see ORNL-2652.) (W.D.M.)

15000 UCRL-Trans-498(L)

THE NUMBER OF LIMIT CYCLES ARISING IN THE CASE OF VARIATION OF COEFFICIENTS FOR AN EQUILIBRIUM STATE OF THE FOCUS OR CENTER TYPE.

N. Bautin. Translated by Mary D. Kilpatrick from *Compt. rend. acad. sci. (U.R.S.S.)* **24**, 669-72(1939). 6p. JCL or LC.

15001

INTERPOLATION IN SEVERAL VARIABLES. Henry C. Thacher, Jr. (Argonne National Lab., Lemont, Ill.) and W. E. Milne (Oregon State Univ., Corvallis). *J. Soc. Ind. Appl. Math.* **8**, No. 1, 33-42(1960) Mar.

Techniques for interpolation of functions of more than one independent variable are extended by generalizing in certain directions and by giving three forms of the fundamental formula better adapted to numerical computation. (D.L.C.)

15002

ON CERTAIN ITERATIVE METHODS FOR SOLVING LINEAR SYSTEMS. A. S. Householder (Oak Ridge National Lab., Tenn.) and F. L. Bauer (Gutenberg Univ., Mainz). *Numerische Math.* **2**, 55-9(1960). (In English)

Projection iterative methods for the solution of large linear algebraic systems of equations are discussed generally, with some emphasis on the method of Gastinel. It is shown that the method of steepest descent converges faster than the methods of relaxation and of Gastinel. (D.L.C.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

15003 AD-203848

Westinghouse Electric Corp. Research Labs., Pittsburgh. RESEARCH AND DEVELOPMENT IN HIGH STRENGTH HEAT RESISTANT ALLOYS. Interim Report No. 1 [for] June 27, 1958 through August 26, 1958. L. L. France. Aug. 31, 1958. 12p. Contract NOas 58852-C.

Development of high strength heat resistant alloys based upon the metals tantalum and tungsten and containing appreciable percentages of rhenium, hafnium, zirconium, titanium, osmium, molybdenum, niobium or other high melting metals is investigated. The mechanical properties and oxidation resistance of these alloys will be determined with emphasis being placed on these properties at temperatures above 1750°F. A survey was made of the commercial availability and purity of the metals to be used in this work and these metals are currently being ordered. Emphasis was placed on the construction of new equipment or modification of existing equipment to handle these materials. The possibility of using levitation melting as a means of preparing these alloys is currently being examined and a somewhat cursory literature survey concerned only with the alloy systems of interest was initiated. (auth)

15004 AD-230075

Oregon Metallurgical Corp., Albany. DEVELOPMENT OF PROCESS FOR AN ARC CAST 25 TO 50 POUND INGOTS OF TIN REDUCED MOLYBDENUM. Progress Report for Period November 30, 1959-December 31, 1959. Allen D. Abraham. 7p. Contract NORD-18124.

The first arc cast Mo ingot produced was found to be air contaminated. The contamination occurred during either the briquetting process, transfer of the briquetted powder to the inert gas electrode fabrication chamber, or storage of the latter. A procedural sequence for processing was set up to eliminate this contamination. (C.J.G.)

15005 BMI-1403

Battelle Memorial Inst., Columbus, Ohio. PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING DECEMBER 1959. Russell W. Dayton and Clyde R. Tipton, Jr. Jan. 1, 1960. 99p. Contract W-7405-eng-92. OTS.

The creep and stress-rupture properties of annealed and of 15% cold-worked Zircaloy-2 are being determined at 290, 345, and 400°C. Work continued on the development of a AgBr fuel-element leak detector for use in water-cooled reactors. The development of a thermal-neutron-flux monitoring system was directed toward extending the sensing-probe life, increasing the effective instrument range, and improving the instrument reliability. Resistivity of $\text{Al}_2\text{O}_3\text{-MoSi}_2\text{-UO}_2$ ceramic tubes was determined to investigate the effects of MoSi_2 proportion and of extrusion pressure. In the development of corrosion-resistant welding alloys for use with Hastelloy F, a number of alloys are being exposed in boiling Sulfex and Niflex solutions to determine corrosion resistance of these liquids. Corrosion tests in 200°C water for 30 days have shown that the Al-35 wt. % U alloys containing Sn or Zr additives are equivalent to the binary Al-35 wt. % U and superior to 2S Al in their resistance to the corrosion attack of 200°C water. Work was continued on the development of a radiometric-

titration method of determining Al and Fe in portland cement. The investigation of the formation and decay of radiation-induced free radicals was continued. The effect of radiation on the nitration of cyclohexane was studied over the range of 15 to 70 wt. % HNO_3 with a 10-to-1 ratio of organic to acid. An investigation is being conducted on the effects of combined high pressure and temperature on the uranium oxides and on the reactions of uranium oxides with other oxide systems. An irradiation surveillance program on AISI Type 347 stainless steel is continuing. The alloys which are being investigated as alternate cladding materials for the EBR include Nb, Nb-1.84 wt. % Cr, Nb-3.21 wt. % Cr, Nb-4.33 wt. % Zr, Nb-9.95 wt. % Ta-3.31 wt. % Cr, Nb-39.8 wt. % Ti-10.6 wt. % Al, Nb-20.5 wt. % Ti-4.28 wt. % Cr, and V-11.7 wt. % Ti-3.07 wt. % Nb. Experimental work concerned with the development of water-corrosion-resistant Nb-base alloy was completed. Feasibility studies are in progress to evaluate new methods for the detection of oxygen in sodium. Niobium-base binary alloys containing from 10 to 60 wt. % U are being studied to determine the applicability of these alloys as high-temperature reactor fuels. Thorium-uranium and Th-U-base alloys are being investigated with the aim of improving their irradiation stability and corrosion resistance. To aid in understanding fission-gas release from UO_2 bodies during irradiation and post-irradiation heat treatments, the surface structures of various preparations are being examined before and after irradiation. Measurements of fission-gas diffusion from single-crystal UO_2 during post-irradiation heating were initiated. Methods of producing cermets of 90% of theoretical density or better containing 60 to 90 vol. % of ceramic fuel are being investigated. The gas-pressure-bonding process is being investigated as a method of cladding ceramic and cermet-type fuels with Mo and Nb. Various methods of producing dense UC by powder-metallurgy techniques are being investigated. Melting and casting, metallurgical and engineering properties, diffusion studies, and radiation effects of UC are being studied. A fundamental study of the reactions of N_2 with Nb is being made. Experiments were continued in producing UO_2 crystals from the vapor phase. The properties, irradiation damage, and fission-gas retention of fueled-graphite spheres are being investigated in support of the Pebble-Bed Reactor Program. Research on core materials in support of the MGCR program is in progress. The major effort is on the development and evaluation of UO_2 dispersions in BeO or Al_2O_3 and dispersions of UC and UC_2 in graphite. Studies are being conducted to develop fuel, absorber, and suppressor materials for the SM-2. (For preceding period see BMI-1398.) (W.L.H.)

15006 BMI-1433

Battelle Memorial Inst., Columbus, Ohio. THE DIFFUSION OF RADIOACTIVE FISSION PRODUCTS FROM POROUS FUEL ELEMENTS. Stephen D. Beck. Apr. 18, 1960. 27p. Contract W-7405-eng-92. OTS.

The release of fission products from porous fuel elements during irradiation may be largely a diffusion process. An equivalent-sphere hypothesis was proposed to provide a model by which the diffusion can be analyzed. The equations of diffusion were previously solved for infinite conditions. The slow convergence of the formulas makes the previous solutions awkward. In the present investigation alternate formulas were derived which are more suitable under certain circumstances. Tables were prepared from which release rates and accumulations may be evaluated for prescribed conditions. The application of

the analysis to the interpretation of release data is explained. (auth)

15007 CF-60-4-93

Oak Ridge National Lab., Tenn.

SOME EXPERIMENTS ON THE ACCURACY OF THORIA SLURRY SAMPLES. R. P. Wichner. Apr. 21, 1960. 24p. Contract [W-7405-eng-26]. OTS.

Tests were performed on a thorium slurry flowing in a pipe to determine the magnitude of the possible error involved in the sampling process. Evidence indicates that a correct sample is obtained by withdrawing the sample isokinetically (i.e., by facing the sampler into the flow and adjusting the sampler velocity to match the ambient velocity) provided that the sampler is larger than some minimum diameter that is dependent on the mean eddy length and/or the mean particle size. (auth)

15008 HW-61994

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PLUTONIUM FUELS DEVELOPMENT, PLUTONIUM METALLURGY OPERATION QUARTERLY REPORT [FOR] JANUARY, FEBRUARY, MARCH 1959. O. J. Wick. 41p. Contract AT(45-1)-1350. OTS.

Four capsules containing Al-1.65 wt.% Pu and Al-12 wt.% Si-1.65 wt.% Pu were charged into the MTR. These capsules will be irradiated to a burnup of 80 to 100% of the plutonium atoms to determine the stability of the material at high exposures. An additional sixteen capsules containing 5 to 20 wt.% Pu in Al and Al-Si were prepared. A four-rod cluster containing Al-8 wt.% Pu and Al-Si-8 wt.% Pu cores was discharged from the KER Loop 3 facility. No external effect of the irradiation on the cluster was observed and it is now scheduled for examination in the Radiometallurgy facility. A second cluster of this same design is still awaiting assignment of Loop space in KER. Sintering studies of the system UO_2 - PuO_2 have continued. It was found that additions of pure PuO_2 to UO_2 markedly decrease the sinterability. However, further evidence was obtained which indicates that PuO_2 added to UO_2 in the form of the mixed crystal oxide enhances sinterability as previously reported. Bond strengths of 4000 to 5000 psi were obtained with injection cast aluminum cores in Zircaloy tubing. During solidification and subsequent cooling, the shrinkage of the core reduced the outside diameter of 0.030-inch wall Zircaloy tubes 0.003 to 0.006 inch without rupture of the bond. Injection castings made in Zircaloy tubing were plagued with gross porosity. An analysis of the aluminum core in these areas revealed a total gas content of 5 ppm (expressed as H_2). Of the total gas, 16% was nitrogen from incomplete evacuation of the tube with the remainder being principally hydrogen which is thought to come from the Zircaloy tubing. A vacuum tube furnace is being constructed to vacuum outgas tubing before injection casting in an attempt to reduce the hydrogen concentration level. Large scale casting of extrusion billets was performed during the last quarter. One hundred forty-two, $2\frac{1}{2}$ inch diameter by $9\frac{1}{2}$ inch long billets were made containing 0.5 to 5.0 wt.% Pu in aluminum. Melt and billet analyses were in most cases within 5% of nominal desired composition and indicated good homogeneity. Billets of corrosion resistant aluminum base alloys with an addition of a nominal 2 wt.% Pu were cast for extrusion. These materials will be autoclaved at 350 to 400°C in order to evaluate their corrosion resistance in hot water. The 280 ton extrusion press was activated for use with plutonium containing materials. Al-Pu rods were made at an extrusion ratio of 27 to 1 and extrusion constants were determined for alloys of 5, 1.8, and 0.5 wt.% Pu in aluminum. Coextrusions of Al-U alloy

clad in 1100 aluminum with integral end caps were made. Ideal extrusion conditions and optimum billet configurations were not determined. A fillet head weld was developed for closure of Zircaloy clad fuel rods. This new weld design replaces the previously used circumferential weld and results in less costly weld joint preparation, a lower reject rate and greater versatility of application. Torsion and fatigue tests demonstrated the high quality of welds made by this process. Several improvements were made in the design of end brackets for the 19-rod Al-Pu cluster elements for the PRTR. The current design is well suited to investment casting techniques. Assembly, etching, and autoclaving experiments are in progress for the Zircaloy clad Al-Pu spike elements. These studies showed that it is not practical to insert fuel rods into as-received or presized tubing and maintain the required maximum diameter clearance of 0.0035 to 0.004 inch. This problem can most easily be overcome by inserting undersize rods into as-received tubing and sizing the tubing by swaging to give the required gap. The distribution of end clearance between the fuel rod and the end caps or the amount of this clearance seems to have no effect on the behavior of the elements during autoclaving. Elements can be cleaned, etched, wire wrapped, and autoclaved in that order to produce good corrosion resistant films on all Zircaloy surfaces and the spot fusion weld for wire attachment does not require etching prior to autoclaving. Some elements warped during autoclaving but there was no apparent relation between warpage and fabrication method. Tests are continuing to evaluate this problem. Tests are being conducted to resize as-received Zircaloy tubes to give a constant inside diameter. Honing equipment has been developed which is capable of finishing inside tube diameters to within 0.0005 inch total variation. Work is also in progress to use Ballizing to attain inside diameters of this precision in a more economical manner. (For preceding period see HW-60996). (J.R.D.)

15009 MAB-43-SM

National Research Council. Materials Advisory Board. STAFF STUDY ON GRAPHITE FOR MILITARY APPLICATIONS. Joseph R. Lane. May 9, 1957. 18p. Contract DA-49-025-sc-83.

A study was conducted to forecast the adequacy of graphite which will become available as a structural material 5 to 15 years in the future. It was concluded that better quality graphite is required, and in order to achieve necessary improvements, government support should be provided for research, requirements should be described, methods of flaw detection should be improved, and new programs for development of high-temperature graphite should be coordinated with the Atomic Energy Commission. (J.R.D.)

15010 MAB-163-M

National Research Council. Materials Advisory Board. REPORT OF PROCEEDINGS OF THE INVITATIONAL MEETING OF THE PANEL ON CASTINGS AND POWDER METALLURGY OF THE MATERIALS ADVISORY BOARD COMMITTEE ON THE DEVELOPMENT OF MANUFACTURING PROCESSES FOR AIRCRAFT MATERIALS (AMC). Jan. 15, 1960. 407p.

An edited report of proceedings at a panel composed of members from the military services, aircraft, and aerospace industries on castings and powder metallurgy is presented. Concepts of the newer weapons systems and the role that castings may play were discussed along with foundry capabilities and programs of advancement. (J.R.D.)

15011 NAA-SR-3911

Atomics International Div., North American Aviation, Inc.,
Canoga Park, Calif.

CHEMICAL PULVERIZATION OF SINTERED URANIUM DIOXIDE BODIES. PART II. PULVERIZATION SCALEUP, FISSION STUDIES, AND PELLET REFABRICATION. S. Strausberg. May 1, 1960. 67p. Contract AT-11-1-GEN-8. OTS.

A gaseous oxidation-reduction process, whereby sintered UO_2 pellets can be pulverized by a chemical, nonaqueous, nonmechanical method, was scaled up to a $2\frac{1}{2}$ -kg level. The procedure for pulverizing refractory UO_2 bodies was found equally suitable for the comminution of fissiona, a simulated spent reactor fuel. The latter material was fabricated from a mixture of UO_2 and representative fission products, in the form of stable isotopes. These finely divided UO_2 and fissiona powders were successfully refabricated into pellets of greater than 90% theoretical density. Pellets of 98% theoretical density were refabricated, after activating the finely divided powder (to a material of higher surface area), by additional, similar, oxidation-reduction treatments. (auth)

15012 NAA-SR-Memo-1942

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

EFFECT OF EXPOSING URANIUM TO SANTOWAX R AT 350°F. H. E. Kline. May 23, 1957. 9p. OTS.

Disks machined from cast depleted uranium were exposed to agitated Santowax R at 350°F for various periods. Results indicated that due to the strong tendency of uranium to getter dissolved oxygen from organic fluids at 200°F or higher, some form of uranium cladding is required for OMR critical facility experiments. (J.R.D.)

15013 NMI-2081

Nuclear Metals, Inc., Concord, Mass.

FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for November 1959. May 6, 1960. 31p. Contract AT(30-1)-1565. OTS.

Further work with U-10 wt.% Mo alloys is reported in which two roll-clad strips completely encased in beryllium were produced without visible cracks. Data indicate that cracking in the cladding is a result of expansion incompatibility. Experimental work in introduction of krypton into uranium by glow discharge was initiated. Data resulting from examination of 18 uranium base alloys by metallographic and x-ray techniques for beta phase after various heat treatments are tabulated. Thermal analysis of binary beryllium alloys such as Be-Cu, Be-V, Be-Fe, and Be-Ni are reported. Analysis of results obtained from tensile testing of rod fabricated from -200 mesh Brush QMV beryllium was completed. Work on preparing single crystals for tensile testing was continued. Work on isotopic interchange in fuels was initiated and calculated data on U isotope diffusion in U- UO_2 at 1000°C are tabulated. (For preceding period see NMI-2080.) (J.R.D.)

15014 NMI-2082

Nuclear Metals, Inc., Concord, Mass.

FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for December 1959. May 6, 1960. 28p. Contract AT(30-1)-1565. OTS.

A charge of U metal and UC_2 pebbles was heated to about 2200°C twice to obtain homogenization, and extruded. A two-phase system resulted in which the dispersed particles were assumed to be UC. The density of the material was 15.785 g/cm³ and observed particles were 100 to 200 microns. Other tests indicate that dispersion hardening in

such alloys appears possible. Efforts to introduce krypton into uranium by the glow-discharge technique were continued. Data from completed tests are tabulated and design of the hollow cathode electrode which was used is described. The beta phase stability of various compositions of Cr-U, Cr-Nb-U, Cr-U-V, and Cr-Fe-Si-U, and Fe-Si-U in which the additives to U were less than $\frac{1}{2}\%$ each were investigated. Thermal analyses of Be-Ni, Be-Ag, and Be-Pd were conducted. The extent of isotopic interchange in U- UO_2 , and U-UC systems is being investigated. Calculated losses of U^{235} in thermal diffusion are tabulated. Work on deformation of UO_2 crystals included a test in which a single crystal was deformed at 1500°C to a total strain of about 0.2%. The surface of this crystal showed evidence of deformation by slip and kinking. (For preceding period see NMI-2081.) (J.R.D.)

15015 NP-8677

Battelle Memorial Inst., Columbus, Ohio.

DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. M. J. Wahll, comp. Apr. 1960. 122p.

A current listing is presented of selected documents and journal articles in an abstracted form on light metals, refractory metals, high-strength alloys, miscellaneous metals, and special subjects. (W.D.M.)

15016 NUMEC-P-10

Nuclear Materials and Equipment Corp., Apollo, Penna.

DEVELOPMENT OF PLUTONIUM BEARING FUEL MATERIALS. Progress Report for July 1 through December 31, 1959. H. J. Garber. [Jan. 18, 1960]. 49p. Contract AT(30-1)-2389. OTS.

Investigations of the feasibility of utilizing plutonium oxide, alone or in conjunction with uranium and thorium oxides and/or inert additives as a reactor fuel in various forms and in different coolant and moderating environments, were initiated. Experimental studies on the effects of preparation methods on the properties of fuel materials were started. A variety of thorias are being produced to obtain stocks of materials for work on fuel shapes and to gain experience in powder metallurgy. Similar studies are planned for plutonia and urania. Work on other experimental tasks was confined to program planning, design, and procurement of specialized equipment, operation scheduling, and testing equipment already received. A format which will be followed in future reports is included. (J.R.D.)

15017 ONR-5(Vol. 1)

Office of Naval Research, Washington, D. C.

A SYMPOSIUM [ON] MATERIALS RESEARCH IN THE NAVY, [HELD] MARCH 17-19, 1959, PHILADELPHIA, PENNSYLVANIA; PROCEEDINGS. 414p. (AD-217822).

Volume I of information given at a Navy symposium on materials research is presented. Included are twenty-two topical reports on a variety of materials and applications of special interest to naval research. (J.R.D.)

15018 ONR-5(Vol. 2)

Office of Naval Research, Washington, D. C.

A SYMPOSIUM [ON] MATERIALS RESEARCH IN THE NAVY, [HELD] MARCH 17-19, 1959, PHILADELPHIA, PENNSYLVANIA; PROCEEDINGS. 381p. (AD-217823).

Volume II of information given at a Navy symposium on materials research is presented. Included are twenty-seven topical reports on a variety of materials and applications of especial interest to naval research. (J.R.D.)

15019 SCDR-43-60

Sandia Corp., Albuquerque, N. Mex.

PROGRESS REPORT [ON] FOUNDRY METALLURGY STUDIES. L. P. Wilson. Apr. 1960. 11p. OTS.

Since 1957, an investigation by Organization 1621 in cooperation with Organization 4221-4 concerning metallurgical problems associated with the Model Shop Foundry has produced processes which enable the foundry to exceed specification properties. A report in which the problems are discussed is presented as a forerunner of other reports which will be issued by the new developmental foundry in Organization 1621. (auth)

15020 SEP-188

Sylvania Electric Products Inc. Atomic Energy Div., Bayside, N. Y.

METALLOGRAPHIC TECHNIQUES OF U-BASE ALLOYS.

Jason Gross. Feb. 15, 1956. Decl. Mar. 30, 1960. 10p.

Contract AT-30-1-Gen-366. OTS.

Methods are described for metallographic preparation of binary U alloys having small percentages of Mo, Nb, or Si. Details are given of mounting, attack-polish technique, and electrolytic etching. Photomicrographs are shown of sintered specimens of U-Mo and U-Nb and of a cast specimen of U-Si. (auth)

15021 TID-5912

Battelle Memorial Inst., Columbus, Ohio.

METALLOGRAPHIC PREPARATION OF SELECTED

CERAMIC MATERIALS. Charles H. Brady, Richard D.

Buchheit, and Arnold F. Gerds. May 15, 1960. 13p. Contract [W-7405-eng-92]. OTS.

Suggested metallographic procedures are presented as an aid in preparing a number of different types of ceramic materials for metallographic examination. General procedures for mounting and grinding of specimens are given. Specific procedures are included for specimens of graphite, carbon, uranium carbide, thorium carbide, uranium silicide, uranium dioxide, alumina, beryllia, and mixtures of hard particles in soft matrices. (C.H.)

15022 WADC-TR-59-87(Pt. III)

Chicago. Univ. Chicago Midway Labs.

DETERMINATION OF FACTORS GOVERNING SELECTION AND APPLICATION OF MATERIALS FOR ABLATION COOLING OF HYPERVELOCITY VEHICLES.

John H. Bonin, Channon F. Price, and Henry Halle.

Oct. 23, 1959. 146p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: THERMODYNAMICS AND HEAT TRANSFER. Contract AF33(616)-5436. OTS.

The result obtained from tests of samples of fifty-two different materials are presented. The samples were exposed to the high-temperature plasma discharge produced in an air-stabilized electric arc. The sample shape, test conditions and test procedure, and the material behavior are reported upon. (auth)

15023 WADC-TR-59-273

Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio.

A RELAXATION TIME TECHNIQUE FOR MEASUREMENT OF THERMAL DIFFUSIVITY. [Period] covered: September 1958 to May 1959. George Sonnenschein and Robert A. Winn. May 13, 1959. 28p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: THERMODYNAMICS AND HEAT TRANSFER. OTS.

A method has been developed for measuring the thermal diffusivity of solids under conditions of one-dimensional transient heat flow in a semi-infinite plate of finite thickness, adiabatically insulated at one face and subject to a constant thermal flux at the other. The method involves measurement of the time elapsed from start of exposure and of the temperature rise at a point along the direction of heat flow. The feasibility of the technique has been

demonstrated on aluminum, Armco iron, copper, yttrium, and on a plastic laminate, covering the diffusivity range from 7×10^{-4} to $1.0 \text{ cm}^2/\text{sec}$ and temperatures between 25 and 950°C .

15024 WADC-TR-59-405

New York Univ., New York.

DEVELOPMENT OF PROTECTIVE COATINGS FOR RE-

FRACTORY METALS. Summary Technical Report from

June 1, 1958 to May 31, 1959. C. G. Goetzl, P. S.

Venkatesan, and R. F. Bunshah. Oct. 20, 1959. 57p.

Project title: CERAMIC AND CERMET MATERIALS.

Task Title: CERAMIC AND CERMET MATERIALS DEVELOPMENT. Contract AF33(616)-5735. OTS.

A preliminary study of the feasibility of protecting tungsten against oxidation at 1650°C was undertaken. Rhodium was selected from the noble metal group as the most promising metallic type of coating. It was applied by electrolytic deposition, either directly onto thoriated or pure tungsten wires, or onto intermediate coats containing the elements rhenium, chromium and silicon. These sub-coats provided a layer of intermediate expansion characteristics between those of the substrate and the rhodium coat, modified the oxides formed on the surface of the substrate, and/or promoted the formation of liquid phases at the surface that would freely flow and seal exposed areas of the substrate. All substrate wires were thoroughly degassed by a vacuum heat treatment before and after electroplating or vapor deposition of the different coats. The wires were heated by their own resistance to temperature sufficient to effect diffusion alloying and bonding between the different coats and the substrate under protective atmosphere, to permit fusion and flowing of the molten rhodium coating over the wire surface under protective atmosphere, and to expose the coated wires to stagnant or streaming air, at progressively higher temperatures up to 1650°C . (auth)

15025 WADC-TR-59-432

Bell Aircraft Corp., Buffalo.

REFRACTORY INORGANIC MATERIALS FOR STRUCTURAL APPLICATIONS.

Period covered: June 1958 to June 1959. Harry A. Pearl, John M. Nowak, Joseph C.

Conti, and Raymond J. Urode. Dec. 1959. 151p. Project

title: CERAMIC AND CERMET MATERIALS. Task title:

CERAMIC AND CERMET MATERIALS DEVELOPMENT.

Contract AF33(616)-5930.

Thirty-five refractory inorganic material systems were evaluated in exploring possible techniques to prepare refractory inorganic materials into high temperature aircraft structural elements. A system as defined in this program is a specific combination of materials and structure. The fabrication techniques were evaluated by the results of room temperature modulus of rupture, impact and thermal shock tests. The best over-all system was based on 0.003-in. alumina-silica paper impregnated with alumina-silica cement. Specimens of this system were tested at elevated temperature (2000°F) for modulus of rupture, compressive strength, and compressive shear. A state of the art survey on foamed ceramics was also conducted as part of this study. (auth)

15026 WASH-700

Division of Research, AEC.

URANIUM ALLOY NEWSLETTER. Edward Epreman, ed.

Nov. 1956. Decl. Mar. 30, 1960. 25p. OTS.

Argonne National Lab. Annealing experiments of high-purity C-U alloys in the γ region in an Ar atmosphere show that the metal is subject to decarburization. Fourteen binary U-Pd alloys were prepared and examined. Pd solubility in γ U is less than 1 wt.% at 890°C . Seventeen

binary alloys of U-Ru were prepared and examined in the as-cast condition. The corrosion resistance after irradiation of U-Si alloys was tested. Homogeneous U-Ta alloys have not been obtained. Th-rich U alloys were found to be more stable under irradiation than the best U alloys. The effect of heat treatment on microstructure is being studied as part of the effort to understand the effect of alloying on corrosion resistance in Ti-U alloys. Crystal and corrosion studies on U-Zr alloys are reported. Armour Research Foundation. Small ternary additions were found to greatly affect the transformation characteristics of U-Nb alloys, and a hardness change was noted for this alloy. Preliminary data for U-Nb-Zr alloy demonstrated a relationship between the strained matrix and the physical properties of the alloy. Battelle Memorial Institute. Phase relationships between the intermediate delta phases of the U-Mo and U-Ti systems were conducted. U-Zr, U-Mo, and U-Nb alloys were evaluated for use as high-temperature reactor fuels. The kinetics of the beta-to-epsilon decomposition of Zr-U alloys are being investigated. The mechanism of aqueous U corrosion is being studied. Mallinckrodt Chemical Works. In the production of Nb-U alloy by co-reduction there was an indication of insufficient heat. Thermal boosters and a redesigned bomb for improving heat conservation will be investigated. National Bureau of Standards. Experimental work on the U-Pt system is completed. Thermal analyses on U-Pd alloys did not show the U transformations present. Metallographic examination revealed an apparently single-phase structure. Thermal analysis data were collected for U-Ru and U-Rh systems. Attempts to prepare U-Sr alloys by high-frequency induction methods were unsuccessful. Nuclear Metals, Inc. Corrosion tests on Zircaloy-2-clad U alloys were made. Sylvania Electric Products, Inc. Thermal cycling and mechanical properties of U-rich alloys sufficiently stable to permit reactor operating temperatures in excess of 1200°F were studied. Mo-U alloys are the most stable toward alpha-beta cycling. Westinghouse Atomic Power Division. Transformation kinetics of the U-Zr alloys were studied. Serrated stress-strain curves in U-Zr alloys were studied. Alloys in the epsilon and γ conditions as well as aged and prestrained conditions were studied from room temperature to 600°C. (F.S.)

15027 WASH-703

Division of Research, AEC.

NUCLEAR FUELS NEWSLETTER. Edward Epremian, ed. Aug. 1957. Decl. Mar. 30, 1960. 40p. OTS.

Data are given from studies of: density, hardness, and thermal expansion of Th-Pu alloys; phase diagrams of U-Ru, U-Mo, and U-Ru-Mo; corrosion of U-Ru in distilled water at 100°C; transformation kinetics of U-Nb-Zr, U-Nb-Ti, and U-Nb-V; radiation effects on U-Mo SRE fuels; enthalpy and heat capacities of USi_2 and USi_3 ; reaction rates for uranium silicides and O_2 and N_2 gases; bend testing and swelling of powder metallurgy U-Mg; effects of radiation and post-irradiation annealing on room-temperature tensile properties of U; swage-annealing of U-Th; radiation effects on U-Cr; structure of delta-phase U-Zr; volume increase in irradiation of U-Zr; diffusion treatment of cladding defects in Zircaloy-2-clad U-Zr; suppression of UAl_4 formation in U-Al by 3 wt. % ternary additions of other materials; conversion of U_3O_8 to UO_2 in composite Al fuel plates after heat treatment to 600°C; compatibility of aluminum and uranium carbides in compacts; and physical properties of gamma phase U-Nb-Zr. (T.R.H.)

15028 JPRS-2488

CONCERNING THE KINETICS IN THE FORMATION OF

CENTERS OF CRYSTALLIZATION. Yu. V. Grdina and L. A. Bondar'. Translated from *Izvest. Vysshikh Ucheb. Zavedenii Chernaya Met.* No. 4, 73-8(1959). 10p. OTS.

The basic assumptions of Tamman, that any size nucleus will initiate crystal growth, and that nuclei form continuously during crystallization, were investigated. It was found that only an insignificant number of centers are formed after a brief interval at the beginning of crystallization. Measurements do not confirm that the grains are of different sizes. (T.R.H.)

15029 TIB/T4596

THE CURRENT EFFICIENCIES OF ELECTRO-DEPOSITION OF METALLIC TITANIUM IN FUSION ELECTROLYSIS. Shinzo Okada, Makoto Kawane, and Mitsunao Takahashi. Translated from *Kyoto Daigaku Kogaku Kenkyusho Ihō* 6, 57-60(1954). 6p.

In electrolysis using a LiCl-KCl-TiCl₃ bath and using also a diaphragm at the anode (there being no anode effect), it is possible to minimize the consumption of TiCl₃ by Cl₂ generated at the anode by reducing the area of contact between the anode and the bath and raising the current density. The anode efficiency also depends upon the shape and position of the anode in the bath. At the cathode, down to a concentration of 2% of TiCl₃, the current efficiency is over 70%, but if the concentration is less than 2%, Li is deposited, and at about 1% the current efficiency begins to deteriorate rapidly. When the concentration of TiCl₃ is too high during electrolysis more of the TiCl₃ reacts with Cl₂ and in addition as the cathode is raised more TiCl₃ accompanies the flux, thus increasing the loss of TiCl₃. Taking this point into account, the writers consider that the optimum concentration of TiCl₃ for electrolysis is 2 to 4%. (auth)

15030

SOME USES OF AUTORADIOGRAPHY IN THE METALLURGICAL INDUSTRY. Jozsef Fodor (Csepel Iron and Steel Works). *Energia és Atomtech.* 12, 275-8(1959) May-June. (In Hungarian)

The history and principles of autoradiography are reviewed, and some examples are cited of its uses in the metallurgical industry. A detailed account of tracer studies for determining the origin of non-metallic inclusions in steel is based on an article by A.M. Samarin in *Neue Huette*, Vol. 2 (1957), No. 2-3, page 69. The laboratory of the Csepel Iron and Steel Works has used autoradiography, with S^{35} and P^{32} isotopes, to determine the distributions of S and P in ingots and to study the crystallization process in continuous casting. Several of these autoradiographs are reproduced. (JPRS)

15031

METALLURGY AND ATOMIC ENERGY-DIFFICULTY AND RESULTS ACQUIRED. M. Salesse. *Nukleonik* 2, 79-83(1960) Apr. (In French)

As is known, the French atomic program is based in part on reactors cooled with gas and utilizing different moderators such as graphite, heavy water, and beryllium oxide. The tables presented survey the metallurgy situation with respect to reactors. The selection of a Mg alloy for cladding, behavior of fritted beryllium oxide under the effect of radiation and corrosive conditions, and the radiation stability of uranium under high burn-up are the topics considered. (J.S.R.)

15032

THE DEVELOPMENT OF SOME REACTOR METALS IN THE WESTERN WORLD. Karl-Heinz Frank (Institut für Weltwirtschaft, Kiel). *VDI Zeitschrift* 102, 409-23(1960) Apr. 11. (In German)

Various rare metals have achieved added importance in the construction of nuclear reactors. The utilization and price of thorium, beryllium, zirconium, hafnium, and lithium are considered. (tr-auth)

15033

Battelle Memorial Inst., Columbus, Ohio.

REACTOR CORE MATERIALS. Quarterly Technical Progress Review, Volume 3, Number 1. R. W. Dayton and E. M. Simons. Feb. 1960. 60p. \$0.55(GPO) Domestic; \$0.70(GPO) Foreign.

Fuel and Fertile Materials. A review of developments in U, alpha-U alloys, gamma-phase U alloys, dilute U alloys, Pu and its alloys, Th and its alloys, dispersion fuel elements, refractory fuel and fertile materials, diffusion studies, mechanism of corrosion of fuel alloys, and basic studies of radiation effects in fuel materials is reported. Moderator Materials. Development in graphite, Be metal and alloys, Be compounds, and solid hydrides is reported. Nuclear Poisons. Research and development are reported in metallic poison materials and dispersion-control materials. Cladding and Structural Materials. Research on corrosion, radiation effects in nonfuel materials, selected metallurgical aspects of cladding and structural materials, and selected mechanical properties of cladding and structural materials is presented. Special Fabrication Techniques. Developments are reported in melting and fabrication, cladding, explosion forming, welding and brazing, and nondestructive testing. (W.L.H.)

Corrosion

15034 HW-61915

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EVALUATION OF FRETTING CORROSION OF ZR-2. R. J. Lobsinger. Feb. 5, 1960. 10p. Contract AT(45-1)-1350. OTS.

Results of testing performed to induce fretting corrosion of Zircaloy-2 are presented. Three experiments were performed in out-of-reactor high temperature loop facilities using water. Results indicate that the primary factors important in producing fretting are vibration and relative movement. Penetrations from fretting can be very rapid. No hydriding or work-hardening was noted and white oxide was not usually observed in the penetrated area. (J.R.D.)

15035 MND-E-2009

Martin Co. Nuclear Div., Baltimore.

ERDL-NPFO QUARTERLY PROGRESS REPORT NO. 11. C. Elcheldinger. Apr. 1960. 24p. Contract DA-44-009-ENG-3581.

Progress during the period from January to March 1960 in the heat exchanger corrosion test program is reported. A statistically designed autoclave test program is outlined; experimental factors are material, chloride concentration, pH, oxygen concentration, heat treat, stress level, and water phase. Results of a literature survey on the corrosion characteristics of Monel and nickel are reported. Modifications to the corrosion test loop currently in progress include individual secondary systems for model and miniature corrosion test vessels, addition of a 50-kw line heater and addition of a by-pass line around the model superheaters. Results of post-test evaluation of Inconel and Croloy 16-1 model and miniature vessels are reported. The Inconel vessels exhibited excellent corrosion resistance, even though the secondary environment contained more than 1000 ppm Cl. Relatively light corrosion of the

Croloy 16-1 miniature vessel was attributed to low oxygen content of the secondary environment. (For preceding period see MND-E-2008.) (auth)

15036 NMI-1226

Nuclear Metals, Inc., Concord, Mass.

AQUEOUS CORROSION OF THORIUM ALLOYS AND ZIRCALOY-CLAD THORIUM ALLOYS. D. S. Kneppel. Mar. 22, 1960. 49p. Contract AT(30-1)-1565. OTS.

An investigation was made of the ability of thorium alloys extrusion-clad with Zircaloy-2 to survive catastrophic rupture when the core alloy was exposed to high temperature water through a small artificial defect in the cladding. At the same time the aqueous corrosion resistance of various thorium alloys was determined at a series of temperatures, and their activation energies were obtained. Thorium-zirconium alloys containing 5-10 wt. % Zr showed the lowest corrosion rate, 25 mg/cm²/hr, as compared to 150 mg/cm²/hr for unalloyed thorium in 500°F water. Defected specimens of Zircaloy-2 clad unalloyed thorium failed catastrophically after a few hours exposure to 500°F water, whereas a thorium core alloy containing 8.8% Zr showed only slight cracking of the clad near the defect after 132 hours exposure. The attack of the core alloy through the defect in the clad appeared to progress, in part, preferentially along the clad-core interface. Heat treatment of the clad alloys to form a diffusion layer between the clad and core was not successful in preventing the attack along the interface. All additions of 10% of uranium to Th-2% Zr confined the attack to the area just beneath the defect in the clad but resulted in only a slight increase in survival time over the binary Th-2% Zr alloy. (auth)

15037 NMI-1235

Nuclear Metals, Inc., Concord, Mass.

CORROSION OF ZIRCONIUM ALLOYS IN 900 AND 1000°F STEAM. J. Paul Pemsler. Mar. 15, 1960. 25p. Contract AT(30-1)-1565. OTS.

Steam at 900 to 1000°F and 1500 psi is a very corrosive medium for zirconium alloys. Zircaloy-2 and Zircaloy-3 fail after a short time under these conditions. The presence of tin is highly detrimental to the corrosion resistance, while additions of chromium, nickel, and iron, both singly and in combination, extend the life of zirconium-base alloys at these temperatures. The results of the corrosion testing of eleven ternary alloys of zirconium with iron and nickel, nickel and chromium, and chromium and iron are presented. The effect of fabrication and heat treatment is discussed. Life expectancies of the order of two years in 900°F and six months in 1000°F steam before the commencement of spalling may be expected for some of the alloys. (auth)

15038 WADC-TR-59-575

Westinghouse Electric Corp. Research Labs., Pittsburgh. OXIDATION OF TUNGSTEN AND TUNGSTEN BASED ALLOYS. [Period covered] May 1, 1958 to August 15, 1959. E. A. Gulbransen, K. F. Andrew, P. E. Blackburn, T. P. Copan, and A. Merlin. Sept. 1959. 86p. Project title: METALLIC MATERIALS. Task title: REFRACTORY METALS. Contract AF33(616)-5770. OTS.

Work is described on a fundamental study of the oxidation of tungsten and its alloys. To understand the tungsten-oxygen system thermodynamic measurements were made on the oxides WO₃, WO_{2.9}, and WO_{2.72}. The W₃O₉(g) pressures over the solid oxide phases from WO₃ to WO₂ was measured and the homogeneity range of the several oxide phases determined. Kinetic studies were made on sheet and wire specimens from 500 to 1300°C and for a broad

pressure range. Crystal structure studies and photographic studies were made on the oxide scales. All the results suggest that the mechanism of oxidation is very complex. At 500°C and lower the reaction is probably diffusion controlled. Above 600°C localized edge type of reaction adds a complication. Above 1200°C the oxidation reaction is similar to the combustion of graphite. The rate of oxidation is limited by the access of oxygen to the surface. (auth)

15039 YAEC-153

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

CORROSION RATE TESTS OF YANKEE PRIMARY SYSTEM MATERIALS IN HIGH TEMPERATURE DYNAMIC WATER. S. J. Cytron. Sept. 1959. 68p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. OTS.

Three out-of-pile loop tests, varying in duration from 666 to 1284 hours, were conducted in early 1959 under simulated Yankee reactor water chemistry conditions to evaluate the corrosion of various materials selected for use in the primary system of the Yankee reactor. The tests were performed at 600°F, 1800 to 1850 psig, at a flow velocity of 36 to 39 ft./sec, with and without lithium hydroxide additions for pH adjustment, and with and without continuous ion exchange purification, in the case of the lithiated solution. Each test was started with a three-day exposure to 0.92 wt. % boric acid solution, followed by operation with the boric acid removed for the remainder of the test. From the data, stabilized corrosion rates and metal release rates were calculated for the austenitic stainless steels tested. The corrosion behavior of the control rod material (silver-indium-cadmium, 80:15:5 wt. %) in neutral and lithiated water was also studied. Nickel plating and adding small amounts of tin to the alloy were each found to improve the otherwise marginal corrosion resistance of the silver-indium-cadmium alloy. (auth)

15040

SOME ASPECTS OF THE OXIDATION OF MANGANESE IN AIR IN THE INTERVAL FROM 400 TO 1200°C. Arturo Echeverría B. *Anales fac. ing., Univ. Concepción, Chile* 7, 61-5(1958). (In Spanish)

The kinetics of the oxidation of manganese in air in the interval from 400 to 1200°C was studied with micrographic and gravimetric methods. The kinetics of the oxidation of MnO in air was studied in the same interval. The oxidation film consists of a blackish gray external coating and a green oxidation layer between the external coating and the metal. The blackish gray film is Mn_3O_4 and the intermediate film is MnO. The relative thickness of the oxidation film and the effect of temperature on the speed of oxidation were also determined. At temperatures of 800°C the oxidation film on MnO is Mn_2O_3 and Mn_3O_4 . At 900°C and above only Mn_3O_4 is found. The law of isothermal increase and the effect of temperature on the oxidation velocity were also determined. (J.S.R.)

15041

KINETICS AND MECHANISM OF THE HIGH TEMPERATURE OXIDATION OF COPPER ALLOYS AND CUPROUS OXIDE. Pascuala García P. *Anales fac. ing., Univ. Concepción, Chile* 7, 65-8(1958). (In Spanish)

The oxidation of Cu-Si and Cu-Al alloys was studied in air at temperatures from 600 to 1000°C. The isothermal oxidation law was found to be parabolic. The heat of activation of Cu-Al was measured as 35,700 cal/mole by the gravimetric method and 34,900 cal/mole by the micrographic method. The heat of activation of Cu-Si was found

to be 35,900 and 35,800 cal/mole by the gravimetric and micrographic methods, respectively. The mechanism of the oxidation of cuprous oxide to cupric oxide was determined. (J.S.R.)

15042

CORROSION STUDIES. XXIII. PASSIVITY OF THE Sn75-Zn ALLOY. M. Pražák (Staatliches Forschungsinstitut für Materialschutz, Prague). *Collection Czechoslov. Chem. Commun.* 25, 1126-31(1960) Apr. (In German)

Investigations were made of the origin of the easy passivation and good corrosion stability of a galvanic alloy of the type 75% Sn-25% Zn. The potentiostatic polarization curve of this heterogeneous alloy was compared with its components in 1 M NaOH. The potential range of the corrosion of tin and zinc in the active state is such that both phases mutually reduce their solution velocity and therefore reduce the critical passivation current of the alloy. The electrochemical behavior of the galvanic alloy does not correspond to the presence of tin and zinc as independent phases and is explained by a passive layer of another composition existing on the independent metals. This layer exhibits in the passive state a low corrosion current which together with the low critical passivation current explains the good corrosion behavior of the alloy. (tr-auth)

15043

EFFECTS OF ALLOYING ELEMENTS ON THE CORROSION OF ALUMINUM IN WATER AT HIGH TEMPERATURES. K. Videm (Institut for Atomenergi, Kjeller, Norway). *Tek. Ukeblad* 105, No. 18, 6p. (1958). (In Norwegian)

Very pure aluminum corrodes very quickly in water at temperatures higher than 130°C. It is shown that the metal is attacked at the grain boundary. With addition of alloying elements which form phases which are cathodic with respect to the aluminum, the attack is prevented. Additions of iron or nickel are the best. A series of alloys with different concentrations of iron and silicon was investigated, and the best behaved satisfactorily up to 200°C. At higher temperatures, alloys with iron and nickel were found to be superior. (tr-auth)

15044

THE ROLE OF LATTICE MISMATCH BETWEEN OXIDE AND METAL IN THE CORROSION BEHAVIOR OF GAMMA URANIUM ALLOYS. J. N. Chirigos (Westinghouse Electric Corp., Pittsburgh). p.70-8 of "Physical Metallurgy of Stress Corrosion Fracture." A Symposium [held at] Pittsburgh, Pennsylvania, April 2-3, 1959." Thor N. Rhodin, ed. New York, Interscience Publishers, 1959. 405p.

Experiments were carried out on gamma U alloys in order to study the reasons for their discontinuous corrosion failure after a period of steady corrosion in hot water. Alloys of U + 10 wt. % Nb with 0-10 wt. % Zr were found to give the same corrosion behavior and life (to discontinuous failure) when tested in O_2 at 680°F and 12 cm Hg as in water at 680°F and 2650 psi. Use of the Frank-Van der Merwe (F-M) theory of oriented overgrowths in calculations gave the result of 1- μ thick UO_2 films as being sufficient to strain the alloy metal to its breaking point through its coherency to the metal. This agrees well with experiment, which shows that a corrosion product film forms up to ca. 1 μ thickness, after which the thickness remains constant, followed by a weight loss due to flaking and failure by cracking or splitting. Moreover, experiments with exposure of U +

10 wt. % Nb alloys to sulfur and iodine vapors gave discontinuous failure, indicating that the chemical composition of the film or corrosion medium is not important, as suggested by the F-M theory. Further support for the F-M theory is given by plots of corrosion life vs. % Zr and of lattice disregistry vs. % Zr for corrosion of U + 10 wt. % Nb with varying Zr contents; maxima in the former correspond to minima in the latter and vice versa. A plot of corrosion life vs. $1/r^4$, where r is the grain radius, is approximately linear and supports the assumption that the mismatch stress between oxide and metal acts only across the oxide-metal interface over one grain. The activation energy is given by a plot of $-\ln I_0$ (I_0 = corrosion life at $r = \infty$) vs. $1/T$, 26.6 kcal, in agreement with that found by Antill for diffusion of O_2 in UO_2 . Tracer studies confirmed the hypothesis that U alloys corrode by anion diffusion through the oxide in both O_2 and water. It is concluded that there is good evidence for the role of lattice mismatch between metal and corrosion product in governing the corrosion life of gamma U alloys. (D.L.C.)

Fabrication

15045 AERE-M/M-224

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE WELDING OF ZIRCALOY CANS BY ELECTRON BOMBARDMENT. P. E. Madsen. Feb. 1959. 10p.

A simple apparatus for welding small Zircaloy cans by electron bombardment without causing appreciable heating of the can contents is described. (auth)

15046 DMIC-Memo-53

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

NOTES ON THE DIFFUSION BONDING OF METALS.

R. M. Evans. Apr. 20, 1960. 10p. (PB-161203). OTS.

Notes from a literature survey on diffusion bonding are presented. Most of the practical development work has been limited to the application of diffusion bonding to particular products such as nuclear reactor components. Various aspects of diffusion bonding are discussed, and it is pointed out that the metals-joining industry is in need of basic research programs in this area. A bibliography of 23 references and a list of DMIC memoranda are included. (J.R.D.)

15047 HW-60996

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PLUTONIUM FUELS DEVELOPMENT, PLUTONIUM METALLURGY OPERATION QUARTERLY REPORT—OCTOBER, NOVEMBER, DECEMBER 1958. O. J. Wick. Aug. 17, 1959. 28p. Contract AT(45-1)-1350. OTS.

A number of Pu-Al and UO_2 -Pu O_2 Zircaloy clad capsules were fabricated for irradiation in the MTR. In addition, a four rod cluster containing Al 8 wt. % Pu and Al 12 wt. % Si 8 wt. % Pu cores were successfully irradiated and discharged from Loop 3 of the KER. Additional work was performed on the pyrometallurgy of Pu-Al alloys. Extraction of Pu from Pu-Al with molten bismuth was previously described. Studies on the extraction of Pu from the bismuth with molten Al-Si were performed. This step in the process was found to be temperature dependent. Air pressure injection casting of aluminum into Zircaloy-II tubes produced bonds with a tensile strength of 4000 to 5000 psi. Castings made in stainless steel tubing consistently exhibited

densities 5 to 8% greater than castings made in Zircaloy tubing. The majority of this difference is caused by gas porosity in the upper half of the castings, which are fed from the bottom. Casting techniques were developed for the routine fabrication of Pu-Al alloy extrusion billets which meet requirements such as vertical segregation less than 5% of nominal Pu content, radial segregation undetectable by radiography, surface quality sufficient to eliminate need for machining, and porosity insufficient to affect extrusion properties of the material. Startup tests on the 280 ton extrusion press using U-Al and a variety of other aluminum alloys were performed. The effect of extrusion ratio on metal flow was evaluated and preliminary studies on coextrusion cladding were undertaken. UO_2 -Pu O_2 pellets covering a range of Pu concentrations and formed from mixtures of UO_2 with both Pu O_2 and co-precipitated UO_2 -Pu O_2 were sintered at a number of different temperatures. A systematic study is underway to demonstrate solid solution formation on sintering for the entire UO_2 -Pu O_2 system. In addition, sintering studies are in progress based on ultimate sintered density as a function of sintering time, sintering temperature, and Pu O_2 concentration for mixtures of UO_2 with both Pu O_2 and UO_2 -Pu O_2 solid solution. Two new 19-rod cluster designs were developed. The Mark I-D is amenable to remote disassembly and reassembly and the Mark I-E is a more economical version when this feature is not required. Three dummy clusters were completed for hydraulic flow tests. A Mark IB dummy has been flow tested for 260 hours with a flow of 130 gpm at 580°F and a pressure of 1900 psi with no visible effect. This was followed by an additional 277 hours cycling between 300 and 580°F for approximately 45 cycles. Hydraulic pressure drop at 20°C, 150 psi and a flow of 120 gpm was determined to be 8.8 psi. A new welded end closure for PRTR fuel elements was developed to replace the circumferential weld previously used. The new closure is a burn down fillet type head closure which has advantages such as radiography is not required, heat input is about 50% less, and the need of a press fit of the end cap into the tube is eliminated. As much as 0.005 inch clearance can be tolerated without adverse effects on the closure quality. Tensile tests performed on specimen tube welds demonstrated the welds to be superior in strength to the tubes. (auth)

15048 SEP-187

Sylvania Electric Products Inc. Atomic Energy Div., Bayside, N. Y.

THE TERMINAL REPORT ON THE FABRICATION OF HOLLOW CYLINDRICAL FUEL ELEMENTS. J. Fugardi and R. E. King. Feb. 28, 1956. Decl. Mar. 30, 1960. 22p. OTS.

The development of a powder metallurgical method of fabricating high-density hollow fuel elements of various sizes and the equipment used and procedures followed are described. Some of the metallurgical properties of these fuel elements are included. (auth)

15049 UMNE-1

Maryland. Univ., College Park and Allis-Chalmers Mfg. Co. Nuclear Power Dept., Washington, D. C.

SAFEGUARDS EVALUATION OF THE UNIVERSITY OF MARYLAND REACTOR. Dick Duffey, William W. Gerken, Chieh Ho, Robert E. Madey, and Joseph Silverman. Feb. 7, 1960. 95p. OTS.

The University of Maryland Reactor (UMR) is a 10-kw light water-moderated, graphite-reflected, open-topped tank reactor. Maximum unperturbed thermal flux is 2.5×10^{11} n/cm²-sec. The experimental facilities consist of two

beam tubes, one through tube, a thermal column, and a sample-holding fuel element. The reactor and nuclear characteristics, the site, and building are described. The administration and operation of the reactor are outlined. The analysis of reactor hazards is presented. (W.D.M.)

15050

WADC-TR-59-500

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

BERYLLIUM RESEARCH FOR DEVELOPMENT IN THE AREA OF CASTING. Period [covered] June 15, 1958 to October 14, 1959. Frank A. Crossley, Arthur G. Metcalfe, and William H. Graft. July 31, 1959. 102p. Project Nos. 7021 and 7351. Contract AF33(616)-5911. OTS.

Various aspects of the casting of beryllium have been investigated as follows: (1) X-ray determination of the direction of columnar growth in cast beryllium; (2) consumable arc melting; (3) reported allotropy by thermal analysis; (4) grain-refining inoculants; and (5) application of vibration to cast beryllium for grain refinement. A very pronounced thermal arrest was found 5 to 10°C below the solidification temperature. Also, transformation markings were observed metallographically. No preferred orientation of columnar grains was found. Consumable arc-melting experiments showed grain size from 316 grains/in² to 616 grains/in². Rust-colored tantalum nitride, WC, and TiB₂ apparently nucleated beryllium solidification to produce grain refinement. Also, an alloying addition of 1 at.% Ge produced grain refinement. (auth)

15051

THE WORKABILITY OF CAST IRON WITH SPHEROIDAL GRAPHITE. Tso-Mei Chang, U-yung Shü, Tze-ming Gau, and Sheng-chuen Kuoh (Inst. of Metal Research, Academia Sinica, Peking). *Sci. Sinica (Peking)* 8, 110-31(1959) Jan. (In English)

The workability of cast iron with spheroidal graphite was investigated by the following tests, in the as-cast and annealed condition: tensile tests, compression tests, Charpy impact tests, impact tensile tests, twisting tests, upsetting tests under the drop hammer, and small-scaled rolling tests. Results show that the best hot-working temperature range varies with the stress system applied and the speed of working, and is 700 to 1100°C. Within this range, the maximum amount of working permissible for a single working operation varies considerably with the stress system applied. Under tensile stresses, the maximum amount of working is 28 to 57.6%; under predominantly compressive stresses, it is 58.5 to 72.9%; in the small-scaled rolling tests, the maximum reduction in thickness permissible for a single pass is 38.6 to 44.3%. The maximum amount of working permissible is affected by the speed of working, being greater at lower speeds. Tests on an industrial scale show that the upsetting and small-scaled rolling tests give results nearest to those from industrial tests. Charpy impact tests, impact tensile tests, upsetting tests, and small-scaled rolling tests show more prominently the best hot-working temperature range than the other tests conducted. Indications are that cast iron with spheroidal graphite has a higher strength and workability when subjected to compressive stresses than to tensile stresses, and that a brittle temperature range has been recorded at 200 to 650°C which varies with the speed of testing. From the variation of the deformation resistance with the change of temperature and the speed effect, this phenomenon is probably associated with blue brittleness. (auth)

15052

CEMENTED CARBIDES. Paul Schwarzkopf and Richard Kieffer. New York, The Macmillan Company, 1960. 356p.

The development of cemented carbides is discussed, beginning with the work of Moissan which opened the way for the industrial production of refractory carbides and other hard metals. Cemented carbides are presently used for high-speed machining of metals, rock and coal drilling equipment, dies, and for an increasing number of other applications where wear and corrosion resistance is important. Sintering cemented carbides is imperative since it is not possible to obtain useful products by melting due to the decomposition of the monocarbide, WC. The basic materials for cemented carbide production are: tungsten trioxide, tungstic acid, ammonium paratungstate, or tungsten powder; titanium dioxide; tantalum powder, tantalum pentoxide, or ferrotantalum-niobium; cobalt oxide or cobalt powder; and carbon black. Heterogeneous and homogeneous end products such as sintered carbides and metallic refractories are described. The methods utilized in testing initial constituents for harmful contaminants and the final cemented carbide tips for suitable performance are explained. The properties of the various compositions are discussed with emphasis on WC-Co; multicarbide; corrosion-resistant, heat-resistant, and experimental tungsten carbide-base compositions; and tungsten-free tool materials. Of the other "hard materials" investigated for possible synonymous use with the cemented carbides, only aluminum oxide and boride materials were found to be comparable. Corresponding to their present technical importance, wear-resistant parts may be divided as follows: (1) drawing dies; (2) mining equipment; (3) projectile cores; and (4) other parts for tools, machinery, and instruments. In the discussion on machining, the European reference system for designating cutting angles, planes, etc., is correlated with the American system. (B.O.G.)

15053

AN IMPROVEMENT IN A METHOD OF OBTAINING SINTERED BERYLLIUM OXIDE. (to Commissariat a l'Énergie Atomique). British Patent 833,667. Apr. 27, 1960.

A process is presented which produces sintered BeO by calcining Be(OH)₂ and sintering at 1700°C and high pressures. A small quantity of acid ions or Be salt of mineral acid is added up to 1%. BeSO₄ is recommended. This addition lowers the time, temperature, and pressure of sintering. (T.R.H.)

Properties and Structure

15054 A-2573Z(WEC)

Westinghouse Electric Corp. Aviation Gas Turbine Div., Kansas City, Mo.

DEVELOPMENT OF NIOBIUM-BASE ALLOYS. Quarterly Progress Report No. 3 for November 1, 1958 to February 1, 1959. R. T. Begley. Feb. 10, 1959. 41p. Contract AF33(616)-5754.

Strain aging studies using floating zone-melted niobium continued. Tensile data on niobium binary and ternary alloys were obtained at room temperature and 1093°C. A Nb-5 wt.% Mo-5 wt.% Hf alloy, tested in air, had an ultimate tensile strength of 43,350 psi at 1093°C. Dilute Zr and Hf additions were found to significantly increase the recrystallization temperature of niobium. Workability and hardness data for niobium with binary additions of Zr, Hf, V, Mo, W, Al, Re, and Y are presented. (For preceding period see WADC-TR-57-344, Part II). (auth)

15055 AD-229808

Westinghouse Electric Corp. Research Labs., Pittsburgh. **RESEARCH AND DEVELOPMENT IN HIGH STRENGTH HEAT RESISTANT ALLOYS.** Interim Report No. 7 [for]

June 27, 1959 through August 26, 1959. L. L. France. Sept. 10, 1959. 39p. Contract NOAs 58852-C.

The preliminary 2000°C isotherms of the Hf-Ta-W and Re-Ta-W alloys are presented. A preliminary summary of the as-annealed structure and hardness is given. Both the 3000°C annealing furnace and enclosed forging hammer chamber were completed. Preliminary melts of Fe, Mo, and Nb and trial forgings of Mo and Mo-W were made. The chemical and physical properties of Ta, W, and their alloys are discussed. Methods of metallographic specimen preparation and etching are reviewed. (See also AD-225461.) (C.J.G.)

15056 AE-25

Aktiebolaget Atomenergi, Stockholm.

A STUDY OF SOME TEMPERATURE EFFECTS ON THE PHONONS IN ALUMINIUM BY USE OF COLD NEUTRONS. K.-E. Larsson, U. Dahlborg, and S. Holmryd. Apr. 1960. 34p.

Using the cold neutron scattering technique about 300 phonons have been determined in a single aluminum crystal at room temperature to define 10 pairs of dispersion curves. Investigations were made of the variation of frequencies, phonon line widths and multi-phonon spectra at $293 \leq T \leq 932^\circ\text{K}$. For a particular direction in the crystal lattice it is shown that the frequencies vary about 15% over this temperature range. The line widths are of such a magnitude that the derived phonon mean free paths vary from about 5 phonon wave lengths at 600°K to about 1.5 phonon wave lengths at 930°K . The observed multi-phonon spectra are found to agree with calculated differential cross sections in the incoherent approximation. (auth)

15057 IGR-TM/C.0123

Battersea Coll. of Technology, London.

OPTICAL AND X-RAY MICRO BEAM EXAMINATION OF CAST URANIUM. C. R. Hill and D. Lewis. Nov. 1957. 11p. Contract Ris 16078 A.

A study to obtain information on the size and nature of uranium sub-structure was conducted. The first stage of such an investigation in which comparative studies of various samples were made by x-ray and metallographic techniques is described. (J.R.D.)

15058 NAA-SR-Memo-1837

Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.

REVIEW OF LITERATURE ON THERMAL EXPANSION OF CERMET COMPONENTS AND METAL-CERAMIC INTERFACE REACTIONS. D. J. Klein. Jan. 17, 1957. 14p. OTS.

A number of reports are reviewed for content bearing on the subjects of thermal expansion and metal-ceramic interface reactions. Where possible, results are presented in abbreviated form, and the extent of further results given in the report is indicated. For the sake of brevity, little mention is made of experimental methods except where a particularly complete description is given in the report. These abstracts are useful for preliminary screening of materials for certain applications, but the reader is referred to the reports themselves for more complete information as well as an assessment of its reliability. (auth)

15059 NP-8637

Minnesota. Univ., Minneapolis. Inst. of Tech.

THE NATURE OF THE NUCLEATION OF PRECIPITATES IN THE SILICON-LITHIUM SYSTEM. Technical Report No. 2. J. W. Ferman and R. A. Swalin. Apr. 4, 1960. 18p. Contract Nonr-710(27).

The concentration dependence of the kinetics of pre-

cipitation of lithium from silicon was investigated. The precipitation kinetics follow a simple exponential decay process for the last 50% of the precipitation. From this portion of the process, values of τ , the characteristic time, were calculated, and the following relation appears to be valid: $1/\tau = C_0^{1/2}$, where C_0 is the lithium content at the initiation of precipitation. A microscopic technique was devised to delineate precipitate particles. It was deduced that the number density of nuclei is proportional to but not equal to the concentration of dissolved oxygen. Further, the number density of nuclei is independent of C_0 , the initial lithium content. The suggestion is made that the nucleation catalyst consists of a complex containing oxygen and some type of lattice defect. (auth)

15060 NP-8669

Battelle Memorial Inst., Columbus, Ohio.

INVESTIGATION OF SINTERABLE POWDERS AND BERYLLIUM OXIDE PROPERTIES. Quarterly Report No. 4. J. E. Johnson, C. Hyde, and W. H. Duckworth. Apr. 15, 1960. 17p. Contract AF33(616)-6238.

The scatter in modulus-of-rupture data of MgO specimens was reduced by surface grinding. An attempt to characterize sinterable MgO powders by differential thermal analysis was unsuccessful. Experiments are reported in which the relation of calcining conditions with MgO powder sinterability was examined. The most sinterable powder was obtained by calcining MgCO_3 at 1500°F . Using this powder, an experiment was also conducted to evaluate the strength of ceramics sintered with various heating rates to 2750°F . The highest density (about 96.8% theoretical) was obtained by heating specimens at 400°F per hour. Specimens heated at 100, 250, or 400°F per hour had essentially the same modulus of rupture. This may indicate that strength is not sensitive to this variable. Data on newly obtained BeO powder are tabulated. It was observed that these powders are not particularly sinterable. Ceramics were produced with densities of 94 to 95% of theoretical when compacted for 2 hours at 40,000 psi and sintered for 2 hours at 2750°F in hydrogen. (For preceding period see NP-8039.) (J.R.D.)

15061 OOR-906:14

California. Univ., Berkeley and California. Univ., Berkeley. Minerals Research Lab.

STUDIES OF ALLOY THERMODYNAMICS BY LIQUID TIN SOLUTION CALORIMETRY. Final Report for November 1, 1953 to October 31, 1958. Raymond L. Orr and Ralph Hultgren. Apr. 1, 1960. 16p. Contract DA-04-200-ORD-171.

A liquid tin solution calorimeter capable of accurate measurements of alloy heats of formation as well as other types of thermodynamic measurements was developed and applied to the thermodynamic study of a number of alloy systems. The accomplishments of this study were reviewed mainly by reference to previous technical reports and published papers which have been submitted. The technical reports, published papers, and graduate theses resulting from this research are listed, and an evaluation is made of the progress made. (auth)

15062 OOR-1719:5

Johns Hopkins Univ., Baltimore.

AN EXPERIMENTAL STUDY OF THE APPLICABILITY OF THE STRAIN RATE INDEPENDENT THEORY FOR PLASTIC WAVE PROPAGATION IN ANNEALED ALUMINUM, COPPER, MAGNESIUM, AND LEAD. Technical Report No. 5. James F. Bell. Mar. 1960. 41p. Contract DA-36-034-ORD-2366.

Results of an experimental study on plastic wave propagation in longitudinal rods are presented. Large wave

propagation was investigated in Al, Cu, Mg, and Pb. It was shown that for annealed Al and Cu undergoing constant velocity impact, the one dimensional strain rate independent theory of plastic wave propagation applies after the first diameter. It was also found that slopes of the static stress-strain curve may be used to determine the velocities of propagation and maximum strain. (J.R.D.)

15063 SEP-255

Sylvania Electric Products Inc. Research Labs., Bayside, N. Y.

DIMENSIONAL INSTABILITY OF URANIUM—IV. Final Progress Report [for] July 1, 1958—March 31, 1959. R. Resnick, L. S. Castleman, and L. Seigle. Feb. 1960. 27p. Contract AT(30-1)-2101. OTS.

Several experiments were performed in order to provide experimental basis for the diffusional theory of the dimensional instability of uranium. Alpha-uranium rods possessing a constant preferred orientation but varying grain size were irradiated in the MTR. Contrary to a prediction based on the theory, no significant effect of grain size on irradiation-induced growth could be detected. Also, the self-diffusion coefficient of alpha-uranium was measured as a function of crystallographic direction, since the theory is based on the anisotropic diffusion of vacancies. The average of two measurements made in each direction at 640°C are:

$$\begin{aligned} D_{[100]} &= 1.8 \times 10^{-14} \text{ cm}^2/\text{sec.} \\ D_{[010]} &= 0.72 \times 10^{-14} \text{ cm}^2/\text{sec.} \\ D_{[001]} &= 0.66 \times 10^{-14} \text{ cm}^2/\text{sec.} \end{aligned}$$

The anisotropy is not nearly so large as had been anticipated, and the above differences are within the experimental error. (auth)

15064 WADC-TR-55-150(Pt. 8)

Battelle Memorial Inst., Columbus, Ohio.

MATERIALS-PROPERTY-DESIGN CRITERIA FOR METALS. PART 8. THE CREEP BEHAVIOR OF SELECTED MATERIALS IN THE RANGE UP TO 1 PER CENT NET CREEP STRAIN AND 1000 HOURS. [Period] covered February 1, 1958 to January 31, 1959. R. J. Favor, W. P. Achbach, and H. J. Grover. Apr. 30, 1959. 28p. Project title: MATERIALS APPLICATION. Task title: DATA COLLECTION AND CORRELATION. Contract AF33(616)-3965. (PB-161302). OTS.

The objectives of this study were to compile and to evaluate creep strain versus time data on airframe structural materials. The range of interest, as recommended by the Elevated Temperature Task Group of the ANC-5 Panel, includes creep strain up to 1 per cent and time up to 1000 hours. Only two reference sources dealt with creep of airframe structural materials within the conditions of strain and time imposed. Although both of these sources have considerably extended the knowledge of creep behavior in the early stages of creep, it appears that neither has encompassed adequately the regions of interest specified. Reasons for this conclusion are discussed in this report. It should be emphasized that for creep strain above about 1 per cent, both sources of data appear adequate. (auth)

15065 WADC-TR-58-360(Pt.II)

Buffalo, Univ. Carbon and Research Lab.

INVESTIGATION OF ELASTIC AND THERMAL PROPERTIES OF CARBON-BASE BODIES. [Period] covered: May 1958 to June 1959. S. Mrozowski, J. F. Andrew, N. Juul, J. Okada, H. E. Strauss, and D. C. Wobschall. Oct. 1959. 93p. Project title: CERAMIC AND CERMET MATERIALS. Task title: ANP ROVER MATERIALS. Contract AF33(616)-5186. OTS.

In continuation of the work four basic types of carbon were prepared, namely from 1) soft filler and soft binder, 2) soft filler and hard binder, 3) hard filler and soft binder, 4) hard filler and hard binder. Elastic moduli, permanent set, shrinkage and density; electric resistivity and thermal expansion coefficient were investigated in dependence on heat treatment temperature and also the variation of the heat conductivity and electrical resistivity on ambient temperature in the range 1200 to 3000°C. An apparatus for direct determination of the heat diffusivity in the temperature range 100 to 700°C was set up and reasonably good data for the diffusivity coefficient obtained. Studies of ultra-attenuation show that the decay in intensity of transmitted waves is due to: 1) energy losses due to hysteresis effect present for all wavelengths, 2) scatter of waves by pores, observable only when the wavelength becomes shorter than 10 particle diameters. A discussion of the merits of various types of carbons closes the report. (auth)

15066 WADC-TR-59-230

Curtiss-Wright Corp. Propeller Div., Caldwell, N. J.

QUALITATIVE ASPECTS OF FATIGUE OF MATERIALS. Harold N. Cummings. Mar. 31, 1959. 261p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Period [covered]: May 1, 1958 to April 30, 1959. Harold N. Cummings. Task title: FATIGUE PROPERTIES. Contract AF33(616)-5182. (AD-230633).

The variables that affect the fatigue life and strength of structural metals are discussed. Although the table of contents purports to list variables separately, the text reveals the fact that many variables are themselves functions of other variables. This requires that extrapolation, from effects discussed under any set of circumstances to those that might occur under different circumstances, be done with extreme caution. Some of the theories of the mechanism of fatigue are discussed briefly. (auth)

15067 WADC-TR-59-492

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

A STUDY OF TERNARY PHASE DIAGRAMS OF TUNGSTEN AND TANTALUM. Period covered: April 1, 1958 to July 31, 1959. W. Rostoker. July 31, 1959. 92p. Project title: METALLIC MATERIALS. Task title: REFRACTORY METALS. Contract AF33(616)-5678. OTS.

Approximate phase relationships in 36 ternary metal systems based on tungsten and tantalum were investigated. Alloying elements included Mo, Nb, V, Cr, Os, and Re. Some 28 related binary systems were established by review of the literature and supplementary experimental work. (auth)

15068 WADC-TR-59-595

Battelle Memorial Inst., Columbus, Ohio.

METALLURGICAL AND MECHANICAL CHARACTERISTICS OF HIGH-PURITY TITANIUM-BASE ALLOYS. Period covered: February 15, 1958 to August 15, 1959. Richard W. Douglass, Frank C. Holden, Horace R. Ogden, and Robert I. Jaffee. Dec. 18, 1959. 153p. Project title: METALLIC MATERIALS. Task title: HIGH STRENGTH METALLIC. Contract AF33(616)-5462. OTS.

The relationships between mechanical properties, alloy composition, microstructure, and thermal history have been studied for high-purity titanium-base alloys. The alloy systems investigated include Ti-V, Ti-Cr, and Ti-W binary alloys, and Ti-Al-V, Ti-Al-Cr, Ti-O-V, Ti-O-Cr, and Ti-O-Mn ternary alloys. Mechanical-property data include tensile and flow properties, impact behavior, hardness, aging, and cooling-rate data. The

effects of dispersions on the creep of Ti-W, Ti-Cu, and Ti-Si alloys were investigated. The metallurgical principles involved here and in previous work are discussed.

(auth)

15069 WADC-TR-59-603

Massachusetts Inst. of Tech., Cambridge. Lubrication Lab.

FRICITION AND WEAR AT ELEVATED TEMPERATURES. Ernest Rabinowicz. Sept. 15, 1959. 25p. Project title: THE STRUCTURE AND PROPERTIES OF INTERFACES. Task title: RESEARCH INTO LUBRICATION, WEAR AND FRICTION. Contract AF33(616)-5963. OTS.

A new high-temperature friction apparatus was constructed which allows sliding experiments to be carried out at temperatures to 2000°F, in controlled atmospheres, and at speeds varying over a wide range. Tests were run on this machine and on an older machine. These and other results are discussed theoretically in terms of the surface energy—hardness ratio and of the wear coefficient. From the experimental results, it appears that the main influence of temperature on the friction and wear results is through changes of hardness, of surface energy, and of tensile strength. (auth)

15070 WADC-TR-59-606

Michigan. Univ., Ann Arbor. Research Inst.

STUDIES OF HEAT-RESISTANT ALLOYS. [Period] covered: March 15, 1958 to June 15, 1959. A. Phillip Coldren, Jerry E. White, Ronald K. Bowen, and James W. Freeman. Sept. 24, 1959. 107p. Project title: METALLIC MATERIALS. Task title: REFRACTORY METALS. Contract AF33(616)-5466. OTS.

Results are reported for an investigation that was carried out to show the effect of hot working on the structure and properties of heat-resistant alloys. The rupture strength of hot rolled "A" Nickel at 100°F seemed to depend primarily on substructure; internal lattice strains as measured by hardness were relatively unimportant. At 800°F the creep resistance of "A" Nickel appeared to depend on internal strains and substructures more or less equally. The rupture properties of A-286 at 1200 and 1350°F in the hot-rolled plus heat-treated condition could not be correlated with the small variations in the state of the γ' precipitate that were observed. A rough correlation was found between grain size and properties. In a ferritic steel ("17-22-A" V) an improvement in properties was effected by rolling austenite at temperatures too low for recrystallization. In a study of strain aging effects, results of constant-strain-rate tension tests on low carbon steel and A-286 Alloy suggested that forces of chemical attraction between N atoms and Si, Al, or Ti atoms stabilize Cottrell-type atmospheres, permitting them to be effective at higher-than-normal-temperatures. (auth)

15071 WADC-TR-59-681

Michigan. Univ., Ann Arbor. Research Inst.

FURTHER INVESTIGATIONS OF THE EFFECT OF PRIOR CREEP ON MECHANICAL PROPERTIES OF C110M TITANIUM WITH EMPHASIS ON THE BAUSCHINGER EFFECT. Period covered: January 1, 1958 to March 31, 1959. Jeremy V. Gluck and James W. Freeman. Oct. 15, 1959. 63p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: FATIGUE AND CREEP OF MATERIALS. Contract AF33(616)-3368. OTS.

Studies of the effect of creep at 650 to 800°F on room temperature mechanical properties of C110M sheet showed changes characteristic of the Bauschinger effect. After creep in tension, the tensile yield strength was increased and the compressive yield strength was decreased. The

effect after 700°F creep was almost as large as that reported after cold-stretching. The extent of the effect was governed by the creep time and the direction of creep with respect to the sheet rolling direction. Studies of variable strain paths revealed no apparent difference between rapid strain and creep strain in inducing a Bauschinger effect. As creep time or temperature increased, recovery reduced the extent of the effect. Unstressed exposure at 700°F removed the effect. The test stock also exhibited a stress-activated structural instability during creep that increased strength and decreased ductility. Strain hardening was a minor factor. (auth)

15072 WADC-TR-59-702(Pt.II)

Bell Aircraft Corp. Engineering and Research Labs., Buffalo.

MECHANICAL PROPERTIES OF SELECTED ALLOYS AT ELEVATED TEMPERATURES. PART II. DESIGN CRITERIA OF SILICON CARBIDE. [Period] covered: July 1958 to September 1959. Harry A. Pearl, John M. Nowak, and Harry G. DeBan. Jan. 1960. 134p. Project title: MATERIALS APPLICATION. Task title: MATERIALS INFORMATION SERVICES. Contract AF33(616)-5760. OTS.

A study was made of nondestructively testing silicon carbide by density uniformity, dynamic modulus by sonic technique, x-ray diffraction under transverse load, electrical resistivity, and internal friction. Dynamic modulus of silicon carbide was experimentally determined at 80 and 2200°F. Modulus of rupture tests were conducted at 80, 2200, and 2400°F. The variability of the properties of the silicon carbide and the lack of simple correlations between the properties and geometry require the use of a statistical approach to correlate mechanical properties and geometry. A theoretical analysis is presented on the effect of specimen size, surface finish, and methods of loading on the strength properties of silicon carbide. Available literature and manufacturer's property data for various types and forms of commercially available silicon carbide are tabulated. Various areas of possible application of silicon carbide in aircraft and missiles and design parameters for leading edge applications are given. (auth)

15073 WADC-TR-59-779

Wright Air Development Center. Aeronautical Research Lab., Wright-Patterson AFB, Ohio.

AN INVESTIGATION OF THE CENTRIFUGAL FORCE LOADING METHOD OF CREEP TESTING. R. E. Hook, A. M. Adair, and J. W. Spretnak. Dec. 10, 1959. 66p. Project title: SOLID STATE RESEARCH AND PROPERTIES OF MATTER. Task title: DEFORMATION MECHANISMS AND BEHAVIOR OF SOLIDS.

A centrifugal force loading creep testing machine was designed, constructed, and tested. Creep data were obtained for electrolytic tough-pitch copper and evaluated. Binary Ni-Al alloys demonstrate the usefulness of this machine for obtaining relative creep strength data. The data on copper reveals that the specimen grain size has a bearing on the degree of dispersion. A smaller degree of dispersion was associated with a smaller grain size. Heat-treated and prepared identically, specimens from different rods exhibited a significant variation in creep behavior. This variation was attributed to small differences in metallurgical structure, probably due to prior thermal and mechanical history. Tests on binary Ni-Al alloys revealed significant creep strength differences. Considerable scatter of the data for each alloy did not affect the determination of the relative creep strengths. The centrifugal force loading method of creep testing provides an inexpensive evaluation of relative creep strengths of materials. (auth)

15074 WAL-TR-148.1/1

Watertown Arsenal Lab., Mass.

CRACK DEPTH LEAKAGE FLUX CHARACTERISTICS IN FERROMAGNETIC MATERIALS. Patrick C. McEleney. Apr. 1960. 47p. (PB-161513). OTS.

Specimens of six fired gun tubes of varied chemistry and heat treatment, with simulated cracks, were examined with a magnetic recording borescope to determine the minimum magnetization level for adequate sensitivity in crack detection. Little improvement in sensitivity is realized by magnetization levels above 1600 ampere turns and no improvement in scatter of data over that of previous data was noted. (auth)

15075 AEC-tr-4077

"ALLOYS" OF THE BORON CARBIDE-MOLYBDENUM DISILICIDE SYSTEM. G. V. Samsonov, V. S. Sinelnikova, and P. S. Kisly. Translated from *Dopovidi Akad. Nauk Ukr. R.S.R.*, No. 8, 866-8(1959). 3p. JCL or LC.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 1787.

15076 JPRS-2570

VAPOR PRESSURE OF OXIDES OF LITHIUM: BERYLLIUM, BORON, SILICON AND LEAD. An. N. Nesmeyanov and L. P. Firson. Translated from *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Metal. i Toplivo*, No. 3, 150-1 (1959). 5p. OTS.

The vapor pressure of equilibrated heavy oxides of lithium, beryllium, silicon, lead, and fused boron oxide was measured by an integral variant of the effusion method. The vapor pressures of beryllium, silicon, and lead oxides, were measured by vaporization of these substances from an open surface vacuum. The condensation coefficients of these oxides were close to unity. (J.R.D.)

15077

Co-Co₂B EQUILIBRIUM DIAGRAM. P. T. Kolomytsev (Zhukovskii Air Force Engineering Academy, USSR). *Doklady Akad. Nauk S.S.S.R.* 130, 767-70(1960) Feb. 1. (In Russian)

The existence of Co₂B was verified, the maximum boron diffusion in cobalt was determined (up to 0.1% B), and the constitution diagram Co-Co₂B with specimens containing 2 to 8.7% B were prepared. (R.V.J.)

15078

ON THE VALUE OF THE SURFACE ENERGY OF METALS AT THE CRYSTAL-MELT INTERFACE. S. N. Zadumkin (Kabardino-Balkarsk State Univ.). *Doklady Akad. Nauk. S.S.S.R.* 130, 810-11(1960) Feb. 1. (In Russian)

A simple method is suggested for evaluating the surface energy at a polycrystal-melt interface. Results of σ_{12} calculations for body-centered cubic metals and experimental data on surface tension of liquid metals at their melting points are tabulated. The table indicates the interphase tension of metals at a polycrystal-melt interface as 8 to 15% of the surface tension at the melting point. (R.V.J.)

15079

THE EFFECT OF PRASEODYMIUM OXIDE ADMIXTURES ON THE PROPERTIES OF CERTAIN GLASSES. I. I. Kitaigorodskii and M. V. Artamonova (Mendeleev Moscow Inst. of Chemistry and Tech., USSR). *Doklady Akad. Nauk S.S.S.R.* 130, 830-3(1960) Feb. 1. (In Russian)

The influence of praseodymium oxide admixture on properties of lead, barium, and phosphate glass was investigated. The results show that additions of praseodymium oxide produce glasses with improved optical con-

stants, linear expansion, crystallization, and other factors. Structurally, praseodymium in glass is identical to PrF₃. The barium and phosphate glasses are recommended as special light filters. (R.V.J.)

15080

ANALYSIS OF URANIUM FUEL ROD BY X-RAY INVERSE POLE FIGURE METHOD. I. STUDIES ON URANIUM FUEL ELEMENT. K. Taketani and M. Ichikawa (Japan Atomic Energy Research Inst., Tokyo). *J. Atomic Energy Soc. Japan* 2, 190-5(1960). (In Japanese)

In investigations of possible fuel elements for Japan Research Reactor-3, the properties of 10 mm uranium rod were studied. The effect of β -treatment on uranium rod was studied from the points of thermal cycling growth coefficient, thermal expansion coefficient, hardness, and microstructure. As the preparation of the pole figure of a uranium fuel rod was very troublesome, the inverse pole figure method was used to describe the texture of the specimen. The (001) projection of α uranium is used in this inverse pole figure. Intensities of the diffractions from 22 planes of a specimen were measured and used for calculations. Inverse pole figures of β -treated uranium rods rolled at 300 and 600°C respectively were also made. From the results, β -treatment at 720°C was found to have a better effect on the texture of uranium rod than that at 680°C; more homogenous distribution of crystallographic planes could be obtained, which is, therefore, the reason β -treatment at 720°C gives a smaller thermal cycling coefficient. The more homogenous the distribution of the planes in the β -treated specimen, the smaller the thermal cycling coefficient. (auth)

15081

THE DELTA PLUTONIUM TRANSITION TEMPERATURE. R. G. Cope (Mond Nickel Co., Ltd., Acton, Eng.). *Nature* 186, 539-40(1960) May 14.

A brief note is presented on the effects of alloying elements on the delta transition in plutonium in the temperature range 450 to 480°C. (C.H.)

15082

PARAMAGNETIC RESONANCE IN METALLIC EUROPIUM AND INTERMETALLIC COMPOUNDS. Martin Peter and B. T. Matthias (Bell Telephone Labs., Murray Hill, N. J.). *Phys. Rev. Letters* 4, 449-50(1960) May 1.

The results are reported of paramagnetic resonance experiments on Eu metal and the intermetallics EuIr₂ and GdIr₂ carried out in a millimeter wave spectrometer. The resonance line in Eu metal occurs at $g = 1.985 \pm 0.015$, which cannot be explained from the behavior of Eu³⁺. This experiment confirms the metallurgical and magnetic evidence for the divalent state of Eu. No resonance was detected in EuIr₂ which crystallizes in the cubic Laves phase (C15). From its lattice constant Eu was concluded to be in the trivalent state. The resonance in GdIr₂, trivalent state, increases with decreasing temperatures to below the Curie point, where the resonance broadens to a point where observation is no longer feasible. (B.O.G.)

15083

SIGNIFICANT STRUCTURES IN LIQUIDS. V. THERMODYNAMIC AND TRANSPORT PROPERTIES OF MOLTEN METALS. Charles M. Carlson, Henry Eyring, and Taikyue Ree (Univ. of Utah, Salt Lake City). *Proc. Natl. Acad. Sci. U.S.A.* 46, 649-59(1960) May.

Thermodynamic properties calculated for molten metals by the method of significant structures of Eyring, Ree, and Hirai are presented. The application is discussed of the

method of significant structures in predicting the viscosities and self-diffusion coefficients of molten metals at various temperatures and pressures. Data are tabulated on sodium, mercury, copper, and lead. (C.H.)

15084

THE PHENOMENOLOGY OF THE TRANSPORT PROPERTIES OF PURE MOLTEN SALTS. Alfred Klemm (Max-Planck-Institut für Chemie, Mainz). *Z. Naturforsch.* 15a, 173-9(1960) Mar. (In German)

The transport processes in pure molten salts are described by the motions of components whose composition remains undetermined. For the interaction between the components, the coefficients of friction, interaction cross sections, and electrolytic capacity were defined with which the diffusion coefficients, conductivity, viscosity, the exterior transport number, and the relaxation length are representable. For simple models with few components the coefficients can be empirically determined. The values of the coefficients thus obtained give indications on the validity of the model. Apart from known methods, the exterior transport number can be determined from the flow resistance of a diaphragm and the maximum electrokinetic rise on the same diaphragm. (tr-auth)

15085

SUPERCONDUCTIVITY OF VAPOR-DEPOSITED LEAD LAYERS WITH THE ADDITION OF GADOLINIUM. Klaus Schwidtal (Universität, Göttingen, Ger.). *Z. Physik* 158, 563-71(1960). (In German)

The influence of the paramagnetic impurity gadolinium on the superconducting properties of lead was studied. Both components were forced to form an alloy by condensing them simultaneously from the vapor phase on a substrate at low temperature. The superconducting transition temperature (T_c) decreases linearly with increasing Gd content. For T_c vs. Gd concentration the measurements yield $dT_c/dc = -2 \cdot 10^2$ °K. This result is discussed from the viewpoint of the theories by Baltensperger and by Suhl and Matthias, and compared with the results on other systems. (auth)

15086

IMPROVEMENTS IN OR RELATING TO COMPOSITIONS COMPRISING URANIUM DIOXIDE. David Thomas Livey and Peter Murray (to the United Kingdom Atomic Energy Authority). British Patent 835,429. May 18, 1960

Cermets of UO_2 and Si are described which offer improved thermal shock and oxidation resistance. In an example, Si powder (density 2.33) and UO_2 powder (density 10.4) were mixed and cold compacted at 1000 psi and heated in the die at this pressure to 1000°C, whereupon the pressure was raised to 2000 psi and the temperature to 1450°C and these conditions maintained for 10 minutes. These samples had transverse rupture strength of 4 to 6 tsi after quenching from 400°C compared to 0.5 tsi for UO_2 only. (T.R.H.)

Radiation Effects

15087 AFOSR-TN-60-269

Stanford Research Inst., Menlo Park, Calif.

THE INTERACTION OF SLOW ELECTRONS WITH INSULATING CRYSTALS. I. THE ABSORPTION COEFFICIENT FOR PURE AND IRRADIATED MgO . Charles J. Cook and William J. Fredericks. Mar. 31, 1960. 20p. SRI Projects SU-2741 and SU-2480. Contract AF49(638)-353. OTS.

An attempt was made to determine the absorption coefficient, δ_a , for electrons incident on MgO and irradiated MgO when the impacting energy ranges from 0.2 ev through the conduction band (about 7.3 ev). It was found that electron trapping was so severe that the crystals would not thermally discharge at temperatures below 350°C. Consequently, the charged crystals were neutralized by a less satisfactory technique, high energy electron bombardment. δ_a was reproducible only at energies less than 4 ev. Inflection points were observed at about 1.80 and 3.00 ev. These "lines" correspond to luminescence spectra obtained for catalytic recombination of N on MgO . Since slow electrons are observed to interact predominantly with crystal defects, the data support suggestions that defects, not structure, can play a dominant role in catalytic reactions. (auth)

15088 AFOSR-TN-60-309

Turin. Istituto Elettrotecnico Nazionale Galileo Ferraris.

Centro Studi per l'Elettrofisica.

EFFECT OF NEUTRON BOMBARDMENT ON THE MAGNETIC PROPERTIES OF IRON AND NICKEL OF VERY HIGH PERMEABILITY. Technical Note No. 2b. [PART] II. Giuseppe Biorci, Andrea Ferro, and Giorgio Montalenti. Dec. 1959. 8p. Contract AF61(514)-1331.

Rings of iron and nickel of good purity annealed for a long time at temperatures close to their melting points in pure H_2 have been prepared. The maximum relative permeability is about 150,000 for iron and 5,000 for nickel. The specimens have been irradiated with fast neutrons (>1 Mev) close to room temperature with doses of 4×10^{17} and 1.2×10^{18} n/cm². The total integrated flux (thermal plus intermediate) was 2×10^{18} and 1.2×10^{19} n/cm². After irradiation no appreciable change in the magnetic properties has been observed on nickel. Possibly this is due to the poor magnetic properties characteristic of this material. On iron, on the contrary, a definite reduction of the maximum permeability and a small increase in coercive force, from 2.5 to 3 A/m has been observed. As the permeability and the coercive force depend mainly on defects which have a size of the order of the Bloch wall thickness (10^3 Å) these results are one of the first experimental evidences that some large defects are also produced by fast neutron irradiation at room temperature. (auth)

15089 CF-53-3-276(Pts. I and II)(Del.)

Oak Ridge National Lab., Tenn.

RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953. PARTS I AND II. Dec. 20, 1954. Decl. with deletions Aug. 10, 1959. Issued in two parts: 184p. (Pt. I) and 229p. (Pt. II). OTS.

A detailed review of radiation damage technology pertaining to reactor fuel element design and fabrication is presented. Also included are studies on the radiation effects on reactor materials. Separate abstracts have been prepared for each paper. (W.L.H.)

15090 CF-53-3-276(Pt. I)(Del.)(P. I-35)

North American Aviation, Inc., [Downey, Calif.].

REACTOR FUEL ELEMENTS AND RADIATION DAMAGE. F. E. Faris and N. Huston. p.1-35 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

A general summary of the present knowledge with regard to the effect of radiation on fuel elements is presented. The relationship of radiation-damage studies to the fuel-element problems in existing reactors having a high density of damaging radiation was investigated. The areas are indicated in which radiation-damage work on fuel-element materials is likely to be most fruitful insofar as the reactor program is concerned. The categories

covered by this work are: metallic fuels, dilute metallic fuels, nonmetallic solid fuels, fluid fuels, and fuel element jackets. (W.L.H.)

15091 CF-53-3-276(Pt.I)(Del.)(p.36-50)

Argonne National Lab., Lemont, Ill.

IRRADIATION DAMAGE TO THE PROPERTIES OF EBR FUEL AND STRUCTURAL MATERIALS. W. F. Murphy, A. C. Klank, J. H. Kittel, and S. H. Paine. p.36-50 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The Experimental Breeder Reactor (EBR) is a liquid metal cooled, fast flux reactor. During early operation, it was found that the reactivity was dropping at a fairly rapid rate. The drop in reactivity was believed to be due to an unprecedented growth of the enriched fuel elements. The EBR core contains normal and enriched U, beta-quenched to promote dimensional stability. Length measurements of the irradiated rods were made and plotted against % burnup. It was found that the growth of normal uranium was small compared with that of the enriched uranium. A series of notched tensile specimens of type 347 stainless steel was irradiated in the reactor to integrated fluxes of 3×10^{18} , 1×10^{19} , 3×10^{19} , and 2.2×10^{20} nvt. (W.L.H.)

15092 CF-53-3-276(Pt.I)(Del.)(p.51-79)

Oak Ridge National Lab., Tenn.

LIQUID FUEL STUDIES IN THE MTR AND LITR. J. G. Morgan and G. W. Keilholtz. p.51-79 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The reactor facilities which were and are being used to irradiate static fused salts at elevated temperatures are: the ORNL Graphite Reactor, LITR, and MTR. The four fuel compositions that were irradiated in the LITR are shown: NaF-KF-UF₄, NaF-BeF₂-UF₄, and NaF-KF-ZrF₄-UF₄. Three irradiations were made in the MTR with NaF-ZrF₄-UF₄ at 1500°F and for periods of from 116 to 575 hr. (W.L.H.)

15093 CF-53-3-276(Pt.I)(Del.)(p.80-92)

Argonne National Lab., Lemont, Ill.

PIN CUSHION TEST ON THE DIMENSIONAL STABILITY OF U²³⁵ AND ITS ALLOYS UNDER IRRADIATION. F. L. Brown, R. J. Fousek, and S. H. Paine. p.80-92 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

Examination of pin specimens after irradiation has shown that surface roughening of U²³⁵ was greatly decreased by small amounts of Zr in wrought alloys fast-cooled from the beta range and by larger amounts of Zr in as-cast alloys. Growth rates of as-cast alloys apparently decreased with Zr content; the growth of beta-treated alloys after initial decrease with small Zr additions apparently increased in an anomalous fashion with increasing Zr content. The additions of Cr to U²³⁵ resulted in greatly decreased growth of alloys isothermally transformed in the high alpha range; however, surface roughening showed no improvement over that of beta treated U²³⁵. (auth)

15094 CF-53-3-276(Pt.I)(Del.)(p.93-7)

Battelle Memorial Inst., Columbus, Ohio.

CONTROL OF FISSION-FRAGMENT DAMAGE. L. D. Loch and J. A. Slyh. p.93-7 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

Fission-fragment damage studies were conducted on samples of graphite and graphite containing 5 wt. % enriched uranium. (W.L.H.)

15095 CF-53-3-276(Pt.I)(Del.)(p.98-112)

Oak Ridge National Lab., Tenn.

FISSION-FRAGMENT DAMAGE. R. H. Kernohan. p.98-

112 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The results of neutron irradiation tests on some graphite-UF₄ specimens are reported. The goal of the investigation was to determine the amount of fission-fragment damage as a function of fuel particle size. (W.L.H.)

15096 CF-53-3-276(Pt.I)(Del.)(p.113-19)

Battelle Memorial Inst., Columbus, Ohio.

EFFECT OF PARTICLE SIZE ON FISSION-FRAGMENT DAMAGE. R. J. Harrison. p.113-19 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

In a homogeneous dispersion of fissionable material in a matrix, fission fragments will cause damage throughout the entire material, even when the amount of fissionable material, in terms of fractional weight or volume, is small. The atomic displacements within the damaged regions will determine the change in property within those regions, and the change in the bulk property of the matrix material will depend upon the change of property within the damaged regions, upon the geometry of the damaged regions, and upon the laws of compounding for the particular property under consideration. The four steps for obtaining a quantitative formulation of the process described are presented: per cent volume of matrix subject to fission-fragment damage, relative exposure in damage volume, change of property in damage volume, and change in over-all bulk property. (W.L.H.)

15097 CF-53-3-276(Pt.I)(Del.)(p.120-35)

North American Aviation, Inc., [Downey, Calif.].

IN-PILE EXPERIMENTS ON THE THERMAL CONDUCTIVITY AND THE OUTGASSING OF IMPREGNATED GRAPHITE. D. J. Klein, D. L. Hetrick, W. K. McCarty, and G. N. Steele. p.120-35 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

An experimental determination of the outgassing of U-impregnated graphite under irradiation was carried out in the Hanford DR Reactor. Two specimens of AUF graphite 1 5/16 in. in diam. and 4 in. in length were impregnated to a density of 3.3 mg/cc of U²³⁵, in the form of the oxide with highly enriched U. The observed pressures, temperatures, and amount of gas liberated as a function of exposure are reported. A determination of the change of the thermal conductivity with fission damage was carried out in Hanford D Reactor. The samples were of AUF graphite machined out of the center of the billet for uniformity and cylindrical isotropy. Density of impregnation was ~24 mg/cc. Data are presented on the relative thermal resistivities calculated from differential temperature measurements and the relationship between relative thermal resistivity and control temperature and the exposure. (W.L.H.)

15098 CF-53-3-276(Pt.I)(Del.)(p.136-43)

Argonne National Lab., Lemont, Ill.

DIMENSIONAL STABILITY OF URANIUM IRRADIATED IN THE MTR. J. H. Kittel, P. Tedeschi, F. R. Taraba, and S. H. Paine. p.136-43 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The effects of irradiation on the dimensional stability of 300°C-rolled U and on 300°C-rolled beta-quenched U were investigated. Also investigated were the effects of irradiation on the density of U. (W.L.H.)

15099 CF-53-3-276(Pt.I)(Del.)(p.144-7)

Oak Ridge National Lab., Tenn.

EFFECT OF REACTOR RADIATION ON THE CORROSION OF STAINLESS STEEL BY FISSIONING SOLUTIONS. F. J. Sweeton. p.144-7 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

A method which is being used at ORNL to study the corrosion of materials by homogeneous reactor solutions in the presence of a neutron flux is described. The effort was mainly confined to UO_2SO_4 solutions in type 347 stainless steel at a temperature of 250°C. (W.L.H.)

15100 CF-53-3-276(Pt.I)(Del.)(p.148-52)

Knolls Atomic Power Lab., Schenectady, N. Y.
BEHAVIOR OF RARE GASES IN METALS. M. B. Reynolds. p.148-52 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The bulk diffusion of gases in metals was studied. Some typical constants for bulk diffusion are given. The sizes of the rare-gas atoms are compared with those of some typical metals. The difference in diffusion behavior between the rather large helium atom and the small tritium ion is discussed. The rare gases are not normally soluble in metals and if they are dissolved by some abnormal means, they tend to come out of solution at a rate limited by the diffusion rate. The concentration of rare-gas atoms which may be obtained in a metal as a result of the fission processes is discussed. (W.L.H.)

15101 CF-53-3-276(Pt.I)(Del.)(p.153-5)

Oak Ridge National Lab., Tenn.
XENON-135 IN FLUORIDE FUELS. M. T. Robinson. p.153-5 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

An experiment was performed to determine the fate of Xe^{135} produced by fission in the fused-fluoride aircraft reactor fuels. The plan was to expose two samples of fuel to the same dose of thermal neutrons. In one run Xe^{135} was to be completely removed by bubbling He carrier gas through the melt. In the other run the carrier was to pass slowly over the surface of the melt, removing only that Xe which diffused out of the liquid phase. Results of the experiments are shown. (W.L.H.)

15102 CF-53-3-276(Pt.I)(Del.)(p.156-9)

Argonne National Lab., Lemont, Ill.
RADIATION DAMAGE AND THE METAMICT STATE. W. Primak and L. Fuchs. p.156-9 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

A history of radiation damage of metamict minerals is presented. (W.L.H.)

15103 CF-53-3-276(Pt.I)(Del.)(p.160-4)

Argonne National Lab., Lemont, Ill.
EXPOSURE AND DOSAGE FOR RADIATION-DAMAGE EXPERIMENTS. W. Primak. p.160-4 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

A numerical expression is derived for the calculation of exposure and dosage for radiation-damage experiments. (W.L.H.)

15104 CF-53-3-276(Pt.I)(Del.)(p.165-9)

North American Aviation, Inc., [Downey, Calif.].
ON THE NATURE OF RADIATION DAMAGE IN METALS. J. A. Brinkman. p.165-9 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

A comparison of the proton and deuteron damage in 0.0024-in.-thick pure Th foil and a 0.0027-in.-thick 97% gold -3% thorium foil was made. The change in the resistivity at -180°C of each specimen was monitored as a measure of the damage. (W.L.H.)

15105 CF-53-3-276(Pt.I)(Del.)(p.170-2)

Argonne National Lab., Lemont, Ill.
FAST-NEUTRON RADIATION-DAMAGE FUNCTION FOR GRAPHITE. W. Primak. p.170-2 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

A method is presented for experimentally determining the nature of the radiation damage function $D(E)$. (W.L.H.)

15106 CF-53-3-276(Pt.I)(Del.)(p.173-96)

North American Aviation, Inc., [Downey, Calif.].
A MODEL FOR RADIATION DAMAGE. R. L. Carter. p.173-96 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

Two phases of the work are discussed. The first is the construction of an electronic bond theory for graphite. The second is concerned with the annealing behavior of irradiated graphite. This work is being directed toward construction of a physical model consistent with both phases. (W.L.H.)

15107 CF-53-3-276(Pt.I)(Del.)(p.197-204)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
DISORDER IN NEUTRON-IRRADIATED GRAPHITE. J. R. Townsend. p.197-204 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The purpose of this work is to present some data on the effects of neutron irradiation of graphite and to discuss these effects in terms of the disorder present in irradiated graphite. Data from x-ray diffraction, heats of combustion, and thermal conductivity studies are considered. The possibility of equilibrium occurring between damage and annealing of damage at various temperatures is also considered, and experimental evidence of such equilibrium states is given. (W.L.H.)

15108 CF-53-3-276(Pt.I)(Del.)(p.205-11)

Argonne National Lab., Lemont, Ill.
EFFECT OF REACTOR IRRADIATION ON THE ELECTRICAL CONDUCTIVITY OF NATURAL GRAPHITE CRYSTALS. L. H. Fuchs and W. Primak. p.205-11 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

To more fully understand the nature of the changes that occur to the electrical conductivity of porous cryptocrystalline artificial graphite subjected to reactor irradiation, it was decided to examine the effects produced within the individual crystals. The a-axis resistivity is much the same from crystal to crystal, whereas the c-axis resistivity shows distinct variations. This is illustrated by the room-temperature measurements, the temperature coefficients, and the irradiation behavior. It is apparent that the axial-resistivity ratio (c/a) of the natural graphite crystals decreases on irradiation. If this decrease also occurs in the individual crystallites of artificial graphite, the current paths will alter as the irradiation proceeds, causing a greater proportion of the electric current to be transported along the c-axis of these crystallites. (W.L.H.)

15109 CF-53-3-276(Pt.I)(Del.)(p.212-52)

Brookhaven National Lab., Upton, N. Y.
OBSERVATIONS OF THE EFFECT OF IRRADIATION ON THE CREEP OF 2S ALUMINUM. E. E. Walsh. p.212-52 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

In the creep experiment the specimens were brought to 350°C and allowed to stabilize. Identical loads were then applied to both specimens. It was expected that the specimens would react somewhat alike. However, due to poor control of the annealing of these specimens, the grain sizes being different, the load on the comparator specimen was reduced to obtain comparable strain rates. (W.L.H.)

15110 CF-53-3-276(Pt.II)(Del.)(p.258-67)

Knolls Atomic Power Lab., Schenectady, N. Y.
RADIATION EFFECTS ON CREEP OF STAINLESS STEEL.

L. F. Coffin, Jr. p.258-67 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

Three irradiations were carried out. Creep slug No. 1 was tested in a dry process-tube facility. The slug contained three test specimens of type 347 stainless steel which were stressed to levels of 18,000, 21,000, and 24,000 psi, respectively, at 600°C. These specimens had received no creep prior to exposure. The test proved to be quite inclusive. Creep slug No. 2 was similar in design to that of creep slug No. 1. As before, no prior creep data were taken. After about seven days of operation, the resistance of all the strain elements in the slug began to rise drastically and after 14 days all circuits had opened up. Slug creep test No. 3 appears to have given the most reliable results. This experiment strongly indicates that the creep rate of type 347 stainless steel is inhibited by neutron radiation at temperatures in the 600°C range. (W.L.H.)

15111 CF-53-3-276(Pt.II)(Del.)(p.268-78)

Oak Ridge National Lab., Tenn.

CREEP OF INCONEL AND STAINLESS STEEL UNDER IRRADIATION. J. C. Wilson, J. C. Zukas, and W. W. Davis. p.268-78 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The purpose of the creep-study program is to determine whether neutron irradiation will affect the creep strength of the metals proposed for use in the Aircraft Nuclear Propulsion Project. In-pile tests of type 347 stainless steel at temperatures from 1200 to 1500°F were carried out, and Inconel was tested at temperatures of 1500 to 1700°F in the ORNL Graphite Reactor and in the LTR where the fast fluxes were 4×10^{10} and 1×10^{12} neutrons/cm² sec, respectively. The stresses, ranging from 1500 to 8000 psi, were chosen to produce total elongations of about 0.2% for 250- to 1000-hr tests at the chosen test temperatures. (W.L.H.)

15112 CF-53-3-276(Pt.II)(Del.)(p.279-86)

Oak Ridge National Lab., Tenn.

EFFECT OF RADIATION ON IMPACT STRENGTH OF METALS. R. G. Berggren. p.279-86 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

Specimens of Fe, carbon steel, stainless steel, and Ti were machined into notched-bar impact specimens and heat-treated; part of each group was then placed in one of several irradiation facilities. After irradiation, both the unirradiated control and the irradiated specimens were tested in a remotely operated impact-testing machine over a range of temperatures. (W.L.H.)

15113 CF-53-3-276(Pt.II)(Del.)(p.287-301)

Argonne National Lab., Lemont, Ill.

EFFECT OF IRRADIATION ON THE NOTCHED-BAR IMPACT PROPERTIES OF SOME PLAIN CARBON STEELS. D. O. Leaser, G. J. Deily, and K. F. Smith. p. 287-301 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The study was initiated in an attempt to establish the effect of irradiation on the impact strength and the ductile-to-brittle transition temperature. Primary emphasis was placed on steels used in pressure vessel construction. Neutron irradiation causes a rise in the impact-transition temperature which becomes greater as the irradiation exposure is increased and/or as the in-pile temperature is lowered. The maximum ductile-impact strength is lowered by irradiation. Neutron irradiation tends to promote a cleavage type fracture even above the transition temperature. While the above three effects are interpreted to mean that irradiation tends to cause brittle behavior, it is to be

noted that all three effects need not be present in any one test. It appears that these effects are, to a degree, independent of one another. (W.L.H.)

15114 CF-53-3-276(Pt.II)(Del.)(p.302-13)

Argonne National Lab., Lemont, Ill.

FATIGUE TESTS ON IRRADIATED AND CONTROL SPECIMENS OF TYPE 304 STAINLESS STEEL, ZIRCONIUM, AND A TIN-ZIRCONIUM ALLOY. D. O. Leaser and J. E. Kemme. p.302-13 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

Fatigue tests were performed on type 304 stainless steel, grade 1 crystal-bar Zr, and a 2½% Sn-Zr alloy. Material history prior to testing is presented. While changes in hardness were recorded, the fatigue strength of type 304 stainless steel is unaffected by irradiation exposures of 10^{20} nvt slow and 10^{19} nvt fast at in-pile temperatures of 140 and 540°F. The effect of irradiation on the fatigue strengths of grade 1 crystal-bar Zr and 2½% Sn-Zr alloy is not significant at exposures of 10^{20} nvt slow and 10^{19} nvt fast with an in-pile temperature of 540°F. The effects of irradiation confirm the assumptions that the fatigue endurance limit of certain materials has a closer relationship to ultimate tensile strength than to yield strength. (W.L.H.)

15115 CF-53-3-276(Pt.II)(Del.)(p.337-57)

Argonne National Lab., Lemont, Ill.

ENGINEERING STUDIES ON RADIATION DAMAGE TO STRUCTURAL MATERIALS. D. O. Leaser and W. F. Murphy. p.337-57 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

Irradiation tests conducted on plain-carbon and stainless steels indicate that softer materials show greater hardening due to irradiation than harder materials, radiation damage is not a direct function of carbon content, the effects of irradiation are preserved at room temperatures but can be reduced to a minimum by post-irradiation heat treatment, and the effects of irradiation proceed at a decreasing rate and probably approach a limit well below the fully embrittled conditions. (W.L.H.)

15116 CF-53-3-276(Pt.II)(Del.)(p.358-69)

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

CORRELATION OF ZIRCONIUM ELECTRICAL RESISTIVITY WITH FAST FLUX. M. L. Bleiberg, R. L. Ely, Jr., and W. F. Witzig. p.358-69 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The results of an attempt to measure the integrated fast flux in the L-41 hole of the MTR and to correlate this with radiation effects on structural materials are presented. It is possible to obtain the functional dependence of electrical resistivity (and probably other physical properties) upon integrated flux in a single MTR experiment. The percentage change in electrical resistivity of 2.5% Sn-Zr alloy as measured at -196°C approaches a saturation value equal to ~10% at integrated fast-flux levels of $\sim 8 \times 10^{19}$ nvt. Apparently, the same effect would be noted in Zr at fluxes somewhat higher than those investigated (6×10^{19} nvt), giving a value ~ equal to a change of 33% in electrical resistivity. (W.L.H.)

15117 CF-53-3-276(Pt.II)(Del.)(p.370-4)

Oak Ridge National Lab., Tenn.

RADIATION STABILITY OF ELASTOMERS AND PLASTICS. C. D. Bopp and O. Sisman. p.370-4 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

A study was made of the radiation stability of elastomers and of a number of plastics and it was found that the stability of the new plastics could be correlated with the

stability of previously studied materials with similar chemical structures. (W.L.H.)

15118 CF-53-3-276(Pt.II)(Del.) (p.375-7)
Oak Ridge National Lab., Tenn.

RELATION OF THE RADIATION STABILITY OF POLYMERS TO CHEMICAL STRUCTURE. C. D. Bopp and O. Sisman. p.375-7 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The basic structure of polyethylene and other structures as modifications of this structure are considered. On a purely physical-properties basis the structures are written in order of radiation resistance. (W.L.H.)

15119 CF-53-3-276(Pt.II)(Del.) (p.378-403)
California Research Corp., Richmond, Calif.
SOME ASPECTS OF RADIATION DAMAGE TO ORGANICS. R. O. Bolt. p.378-403 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The effect of dosage, temperature, and structural changes on a number of organic compounds was studied. (W.L.H.)

15120 CF-53-3-276(Pt.II)(Del.) (p.404-38)
Knolls Atomic Power Lab., Schenectady, N. Y.
GAMMA RADIATION OF ELECTRICAL INSULATION. C. Mannal. p.404-38 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The effects of high-energy gamma radiation on the insulation of an electro-magnetic pump were studied. (W.L.H.)

15121 CF-53-3-276(Pt.II)(Del.) (p.439-43)
Argonne National Lab., Lemont, Ill.
INVESTIGATION OF IRRADIATED URANIUM-STAINLESS STEEL DIFFUSION COUPLES. R. Weil, R. Wager, and S. H. Paine. p.439-43 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

A study of the interdiffusion between U and possible cladding materials was made. A number of experiments on the diffusion between normal U and type 347 stainless steel without irradiation were conducted. Diffusion couples of normal U and stainless steel were irradiated in the CP-3 heavy-water reactor at ANL at a flux of $\sim 4 \times 10^{12}$. The investigation then proceeded with couples composed of 93% enriched U and stainless steel that were permitted to diffuse without irradiation in a flux of 4×10^{12} . No increase in diffusion as a result of irradiation was observed in U-stainless steel couples at thermal fluxes up to 4×10^{12} . (W.L.H.)

15122 CF-53-3-276(Pt.II)(Del.) (p.444-57)
Oak Ridge National Lab., Tenn.
NUCLEAR HEATING IN THE LITR. F. Muckenthaler, F. Smith, and J. B. Trice. p.444-57 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

A major design problem to experimenters planning to irradiate materials in high-flux reactors such as the MTR and the LITR is the extent of cooling required to keep in-pile temperatures within reasonable limits. In order to provide information on how much heat will be generated per gram of material, as a function of material, and position in a reactor, a few representative experiments were performed to measure nuclear heating at several positions in the LITR. (W.L.H.)

15123 CF-53-3-276(Pt.II)(Del.) (p.458-67)
Oak Ridge National Lab., Tenn.
DESIGN AND OPERATION OF HIGH-TEMPERATURE IN-PILE LIQUID-METAL EXPERIMENTS. W. W. Parkinson. p.458-67 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

The design and operation of high-temperature in-pile liquid-metal experiments in ORNL Graphite Reactor and the LITR are reported. (W.L.H.)

15124 CF-53-3-276(Pt.II)(Del.) (p.468-70)
Oak Ridge National Lab., Tenn.
RADIATION FROM AN IRRADIATED LIQUID LITHIUM STREAM. C. D. Baumann. p.468-70 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

Lithium is one of the liquid metals under consideration as a heat transfer medium for the extraction of power from certain types of reactors. Lithium-7, the major isotope of natural lithium, interacts with neutrons to produce radioactive Li^8 , which disintegrates with a half life of 0.88 sec to two alpha particles and a 13.4-Mev beta particle. This beta particle, in being slowed down by the heavy elements associated with the engineering structures of a reactor, may produce high-energy bremsstrahlung, which would create serious shielding problems. The radiation emanating from an activated lithium stream was studied by means of a loop which was installed in the ORNL Graphite Reactor. (W.L.H.)

15125 CF-53-3-276(Pt.II)(Del.) (p.471-7)
Oak Ridge National Lab., Tenn.
DIFFERENTIAL THERMAL ANALYSIS OF IRRADIATED SALTS. C. C. Webster. p.471-7 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

A salt having a relatively high melting point is to be used in a reactor where the fuel will be circulated through a heat exchanger. Before determining the temperature at which to operate the heat exchanger and circulating loop, the melting point of the fuel and the effects of irradiation on this melting point must be known. The absolute melting point of a standard sample taken from the same batch of fuel as the irradiated samples but with no thermal treatment and no irradiation was determined. This was done by a differential-temperature measurement between the standard and a sample of NaCl which is thermally stable in the range of interest. (W.L.H.)

15126 CF-53-3-276(Pt.II)(Del.) (p.478-94)
Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

WAPD EXPERIMENTS IN THE MATERIALS TESTING REACTOR. I. GAMMA HEATING. Warren F. Witzig. p.478-94 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

A maximum value of ~ 12.5 watts/g of gamma heat in Al was measured in the L-42 location at the reactor center line. At steady-state conditions the gamma-heat effect was found to be approximately linear with power level at reactor startup. It was found that the gamma heat in the L-42 location is very dependent upon vertical position. This spatial effect, coupled with a somewhat higher value of gamma heat than was previously expected, makes it more difficult to establish a constant uniform specimen temperature within the active lattice. Such a temperature condition is necessary for creep experiments. Additional tests are under way in the MTR with the use of recirculating helium in an attempt to produce the desired temperature conditions. The feasibility of conducting experiments in the active lattice of the MTR by using bottom entry was demonstrated by the gamma-heat experiment. In this experiment, chromel-alumel thermocouples were exposed to 1425 Mwd of irradiation without permanent damage within a precision of $\pm 0.2^\circ\text{C}$. (auth)

15127 CF-53-3-276(Pt.II)(Del.) (p.495-8)
Oak Ridge National Lab., Tenn.
DYNAMIC RADIATION TESTING FACILITY FOR LIQUID

FUELS. A. E. Richt and J. G. Morgan. p.495-8 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

An investigation was made of the radiation damage of a fused salt fuel flowing out of a high flux field, with corresponding rise or drop in temperature. (W.L.H.)

15128 CF-53-3-276(Pt.II)(Del.)(p.499-507)

Argonne National Lab., Lemont, Ill.

EFFECT OF PILE IRRADIATION ON THE PROPERTIES OF VITREOUS SILICA AND QUARTZ. L. H. Fuchs and W. Primak. p.499-507 of RADIATION DAMAGE CONFERENCE, MARCH 23-24, 1953.

Several polished plates of quartz and vitreous silica were irradiated in a water-cooled test hole in a Hanford reactor. After the irradiation, the plates were found to be clear, except for only a slight uniform tinge of color-pale blue for the vitreous silica and purple for the quartz. No cracks or optical twinning could be observed as a result of the irradiation. The densities of the quartz and vitreous silica plates were measured and the results are shown. The refractive indices of the quartz and vitreous silica plates were determined with an Abbé refractometer illuminated with a sodium lamp. (W.L.H.)

15129 EXP-NRX-1807

Atomic Energy of Canada Ltd., Chalk River Project, Chalk River, Ont.

BEHAVIOUR OF HIGHLY RATED URANIUM OXIDE SPECIMENS IRRADIATED WITH A DEFECTED SHEATH, TEST X-2-q. A. S. Bain and J. A. L. Robertson. Jan. 1960. 27p. (AECL-970). AECL.

A Zircaloy-2 sheathed, sintered UO_2 specimen 6 in. long and 0.8 in. OD was irradiated with a 0.010 in. diameter defect at a heat rating of $\int_{T_3}^{T_0} k d\theta = 48 \text{ w/cm}$ for 16 days.

There was no noticeable change in shape or dimensions of either the fuel element or the defect. The activity in the loop coolant was similar to that recorded for other tests, then rose suddenly to a higher level. The originally stoichiometric oxide exhibited more grain growth than similar material irradiated under comparable conditions in non-defected sheaths. (auth)

15130 NP-8648

Reynolds Metal Co., Richmond, Va.

DESIGN OF CONTAINERS FOR IRRADIATED FOOD. Report No. 3 (Final) [for] Period: January 22, 1957-July 21, 1959. H. E. Collins. 10p. Project No. 7-84-01-002. Contract QMR&D (Natick) 67.

Seven combinations of plastic films, aluminum foil, paper, and/or heat seal coatings were used to package four simulated foods. These various combinations were irradiated at pasteurization levels with gamma radiation, stored at room temperature and examined quarterly for over-all changes in physical characteristics. None of the pouches made from these various combinations have shown any significant decrease in physical properties during the nine month evaluation, although there has been some apparent physical degradation of one or more of the components in some instances. On the other hand, there have been some instances where irradiation apparently has slightly improved one or more of the physical characteristics of the materials. (auth)

15131 ORNL-2742

Oak Ridge National Lab., Tenn.

A STUDY OF THE EFFECTS OF FISSION FRAGMENT RECOILS ON THE OXIDATION OF ZIRCONIUM (thesis). William C. Yee. May 13, 1960. 103p. Contract W-7405-eng-26. OTS.

Submitted to the Univ. of Tenn.

The effects of fission fragment recoils on the corrosion of zirconium in an oxygen atmosphere at 250°C were studied. Each of the experiments was conducted in an autoclave unit which contained four zirconium specimens and a source of fission fragments as required. Four runs—three of them with a source—were conducted in the ORNL Graphite Reactor at a maximum thermal neutron flux of 8.5×10^{11} neutrons/cm²/second. The experiment was designed to provide for oxidation of specimens under conditions such as reactor radiations including fission fragment recoils, reactor radiation in the absence of fission fragment recoils, and no radiation. All other variables were maintained as constant as possible. The test specimens were maintained at 250°C while the control specimens operated at 265°C. The results of the analyses made on the zirconium specimens indicated that fission fragment recoils did physically affect the oxide film. Observations may be interpreted as the fission fragment recoils affecting the oxide film such that the oxide underwent a phase transformation and/or the oxide developed a fine particle size with random orientation. The limited data indicated that there was a greater weight gain in the zirconium specimens oxidized in-pile than those oxidized out-of-pile. (J.R.D.)

15132 TID-5786

Connecticut. Univ., Storrs.

INVESTIGATIONS OF RADIATION EFFECTS IN SOLIDS BY ELECTRON SPIN RESONANCE. Progress Report [for] June 16, 1959 to March 15, 1960. Otis R. Gilliam. Mar. 15, 1960. 31p. Contract AT(30-1)-2047. OTS.

Experiments on single crystals of $\alpha\text{-Al}_2\text{O}_3$ indicated no new electron spin resonances due to exposure to gamma rays or to reactor irradiation for irradiations and ESR runs at room temperature. Samples of quality fused silica irradiated with U.V. were observed to give two absorption lines whose measured widths and g-values correspond closely to the electron and hole defects reported previously for x-ray, gamma-ray, and neutron irradiated fused silica. If the unirradiated fused silica is heated to a temperature close to its melting point and rapidly quenched, the same resonances are induced without recourse to irradiation. Single crystals of KN_3 U.V. irradiated at 77°K displayed two defects which were possibly N_2^+ and N_3^+ , according to evidence from their hyperfine structure, symmetry, and annealing characteristics. (auth)

15133

SOME ASPECTS OF THE EFFECTS OF NEUTRONS ON SOLID BODIES. C. Moțoc. Acad. rep. populare Romîne, *Inst. fiz. atomică și Inst. fiz. Studiî cercetări fiz.* 10, 533-57(1960). (In Rumanian)

A review is presented on the recent studies made on the effects of neutrons on solids. The theory of the irradiation displacements and the modification of physical properties are considered. 84 references. (J.S.R.)

15134

THE ELECTRICAL AND PHYSICAL PROPERTIES OF ELECTRIC INSULATION MATERIALS WHEN SUBJECTED TO RADIOACTIVE RADIATION. K. A. Vodopyanov, B. I. Vorozhtsov, G. I. Potakhova, and N. I. Olshanskaya (Siberian Inst. of Physics and Tech., Tomsk State Univ.). *Elektrichestvo* No. 5, 60-6(1960) May. (In Russian)

Data are presented on the effects of γ radiation on electrophysical characteristics of high-polymer dielectrics and silicon-organic and phenol-formaldehyde plastics. The specimens were irradiated in a 15-Mev betatron at dose rates of 300 to 1500 r per minute. The electric strength, electroconductivity as a function of temperature, tempera-

ture and frequency dependence of dielectric losses, and dielectric penetrability before and after irradiation were measured. (R.V.J.)

15135

SLOW NEUTRON IRRADIATION EFFECTS ON DIELECTRIC PROPERTIES OF POLYCRYSTALLINE TITANIUM. L. K. Vodop'yanov and G. I. Skanavi (Lebedev Inst. of Physics, Academy of Sciences, USSR). *Izvest. Akad. Nauk S.S.S.R., Ser. Fiz.* 24, 253-6(1960) Feb. (In Russian)

Irradiation of polycrystals by large thermal neutron fluxes produced large Frenkel-type defects, especially in elements with large effective cross sections for slow neutron capture. It is postulated that the defects create polarization relaxation which increases dielectric losses and polarization when dielectric penetrability before irradiation is not too high (magnesium and zinc titanates). (R.V.J.)

15136

MICROSCOPIC OBSERVATION OF CADMIUM SULFIDE BOMBARDED BY 5-keV ELECTRONS. François Davoine and Pierre Pinard (Institut National des Sciences Appliquées, Lyon) and Michel Martineau (École Polytechnique, Paris). *J. phys. radium* 21, 121-4(1960) Feb. (In French)

Scanning microscopy, used to investigate cathodoluminescence of a CdS crystal, leads to two important results. Only some parts of the crystal are luminescent (those where concentration of primary defects is high). In the spectral region explored (from 3000 to 6000 Å) emission from some of these zones is polychromatic whereas others emit one wavelength only. (auth)

15137

THE EFFECTS OF DEUTERON IRRADIATION ON THE NUCLEAR MAGNETIC RESONANCE IN TEFLON. Hazime Kusumoto (Univ. of Illinois, Urbana). *J. Phys. Soc. Japan* 15, 867-74(1960) May. (In English)

F^{19} magnetic resonance was observed on non-irradiated Teflon and Teflon irradiated by deuterons. Irradiation caused considerable increase of line width and second moment above -75°C , where an abrupt narrowing of line width caused by the onset of the segmental motion of the molecules took place for both samples. This result suggests that there might exist in the irradiated Teflon some molecular structures disturbing the molecular motion, e.g., cross-linkings, double bonds, ring formation, etc., and/or increase of crystallinity by irradiation. A broad line component superimposed on a sharp absorption line observed in the original Teflon around -7°C faded out as a result of the irradiation. The energies and entropies of activation were computed from the line width data. The irradiation gave them the effects similar to those of curing in natural rubber. (auth)

15138

POST-IRRADIATION EFFECT IN VISIBLE ABSORPTION SPECTRA OF POLYVINYL CHLORIDE SHEETS. Yoichi Okada and Takao Ito (Sumitomo Bakelite Co., Ltd., Tokyo) and Ayao Amemiya (Tokyo Univ.). *J. Phys. Soc. Japan* 15, 938-9(1960) May. (In English)

The post-irradiation effects in irradiated sheets of polyvinyl chloride were studied using visible absorption spectrophotometry. Irradiation was done with 10^7 rad of 1-Mev electron beams for 24 hours in air or water, and the absorption spectra of the irradiated sheets were then measured at intervals. Spectrum peaks occurred at 570 and 630 m μ ; the observed color shift from blue to green came from distortion of the spectrum. Two graphs are

given, one for % transmittance vs. wavelength for various time intervals, and the other for $\log I_0/I$ vs. time interval for 570 and 630 m μ ; the curve in the latter graph for 570 m μ (irradiated in water) is fitted well by a first-order kinetic equation, giving a half life of the primary irradiation product (which is then assumed to change into a chromophore) of 32 minutes. (D.L.C.)

15139

RADIATION-INDUCED CHANGES IN α -LEAD AZIDE. G. Todd and E. Parry (Armament Research and Development Establishment, Fort Halstead, Kent, Eng.). *Nature* 186, 543-4(1960) May 14.

Optical, gravimetric, and x-ray methods were used to measure changes in the lattice and decomposition products in x-irradiated alpha lead azide. Findings are discussed. (C.H.)

15140

ATOMIC RADIATION AND POLYMERS. A. Charlesby. International Series of Monographs on Radiation Effects in Materials. Volume 1. New York, Pergamon Press, 1960. 567p. \$17.50.

The interaction of radiation and matter, radiation sources, and dosimetry are discussed. The properties of long chain polymers and a crosslinked network are discussed and methods of network formation are described. Radiation-induced changes in organic molecules, are discussed and data on radiation effects on polyethylene, rubber, polystyrene, silicones, polyisobutylene, polymethyl methacrylate, cellulose and other crosslinking polymers are reviewed. The processes of polymerization, grafting, and polyester curing are discussed. The direct and indirect effects occurring from polymer irradiation in solution, the reactions of irradiated molecules, and the radical and ion yield are analyzed. Mechanisms of polymer cross-linking, degradation, and radiation protection are discussed. (C.J.G.)

PHYSICS

General and Miscellaneous

15141 AFOSR-TN-60-345

Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics and Chicago. Univ. Lab. for Molecular Studies.

APPLICATION OF SUMMABILITY METHODS TO SPECIFIC HEAT CALCULATIONS. A. A. Maradudin, G. H. Weiss, and R. A. Sack. Mar. 1960. 16p. Contract AF18 (600)-1315. (BN-201).

Thirring obtained an expansion for the vibrational contribution to the specific heat of a crystalline solid in powers of $1/T$. The coefficients of this series are proportional to successive moments of the frequency spectrum. Thirring's expansion converges only for $T > \Theta/2\pi$, where $\Theta = \hbar\omega_1/k$ and ω_1 is the maximum normal mode frequency. The series, in addition, converges very poorly near its radius of convergence and is completely useless there. It can, however, be analytically continued beyond its radius of convergence by means of the Euler transformation, which, in addition, greatly increases the rate of convergence of the series near the radius, so that only about seven moments are required for better than three figure accuracy for the specific heat of a body-centered cubic lattice at this point. Other methods for summing divergent series can also be used effectively. Some examples of the use of these methods are presented. (auth)

15142 CERN-60-11

European Organization for Nuclear Research, Geneva.
AN INPUT PROGRAMME FOR MEASUREMENTS OF
TRACK CHAMBER PHOTOGRAPHS. G. R. Macleod.
Mar. 27, 1960. 34p.

The data-processing necessary for the evaluation of a large number of bubble chamber photographs requires the use of a computer to carry out the calculations for the quantities of physical interest such as cross sections, angular distributions, decay spectra, etc. A program written for the Ferranti Mercury computer at CERN to handle measurements made on bubble chamber photographs is described. (W.D.M.)

15143 CERN-60-12

European Organization for Nuclear Research, Geneva.
GEOMETRICAL RECONSTRUCTION FOR DIGITISED PRO-
TRACTOR MEASUREMENTS. G. R. Macleod. Mar. 28,
1960. 19p.

A program is described which was written for the Ferranti Mercury computer at CERN to make reconstruction calculations on measurements of bubble chamber photographs made using digitized protractors. The program carries out the calculations necessary to obtain quantities such as the three-dimensional coordinates of points, direction cosines, and curvatures of tracks from the photographic measurements. (W.D.M.)

15144 CERN-60-16

European Organization for Nuclear Research, Geneva.
UN MÉCANISME DE TRANSPORT DE FILM POUR IN-
STRUMENT POUR L'ÉVALUATION DES PHOTOGRAPHIES.
(A Film Transport Mechanism for an Instrument for Eval-
uating Photographs). Apr. 7, 1960. 30p.

A film transport mechanism is described for measuring tracks in photographs or on a scanning apparatus. The device has a low and a high speed, and takes 150-m reels of 35 or 70 mm film. It is electronically controlled by means of a system of marks on the film. The mechanism does not damage the film and loads easily. (T.R.H.)

15145 HW-62858 (Rev.1)

General Electric Co. Hanford Atomic Products Operation,
Richland, Wash.

EQUATIONS OF STATE FOR STEAM-WATER MIXTURES
AND SOME REPRESENTATIVE APPLICATIONS ANALY-
SIS. W. J. Love. Apr. 18, 1960. 23p. OTS.

Suggested equations of state for two-phase water systems are presented, and their use in certain critical, unsteady, and steady (friction loss) flow situations is demonstrated. Data resulting from determinations of equilibrium equations of state at 10 to 3000 psia are included. (J.R.D.)

15146 HW-SA-1836

General Electric Co. Hanford Atomic Products Operation,
Richland, Wash.

FISSION PRODUCT RELEASE FROM HEATED URANIUM
(thesis). Robert Kirk Hilliard. 1960. 64p. Contract
[AT(45-1)-1350]. OTS.

Submitted to Univ. of Idaho.

An investigation of fission product release from irradiated uranium heated in air and helium is reported. The fission product elements, iodine, tellurium, xenon, strontium, cesium, ruthenium, barium, and zirconium were selected for study. Uranium samples were irradiated with neutrons to 2.4×10^{14} nvt, allowed to cool and then heated and cooled rapidly in tests. Results, expressed as % of the isotope released from the specimen, are tabulated. Predictions related to fission product release during reactor incidents are discussed, and conclusions are included. (J.R.D.)

15147 JPLAI-LS-207

California Inst. of Tech., Pasadena. Jet Propulsion Lab.
ADVANCED METHODS OF PROPULSION. ASTRONAUTICS
INFORMATION LITERATURE SEARCH NO. 207. Edda
Barber. Apr. 6, 1960. 45p. Contract NASw-6.

A bibliography is presented on various methods of advanced propulsion, with emphasis on the nuclear and electrical propulsion systems. Articles of a general nature, survey articles, and material covering methods other than nuclear and electrical systems, such as solar and photon propulsion are also given. Ion propulsion, plasma propulsion, and arc-heated jets are considered in the field of electric propulsion. (W.D.M.)

15148 MH-1

New York Univ., New York. Inst. of Mathematical
Sciences.

ELECTROHYDRODYNAMICS. I. THE EQUILIBRIUM OF
A CHARGED GAS IN A CONTAINER. Joseph B. Keller.
Jan. 1955. 20p. Contract AF-19(604)-926. (AFCRC-TN-
55-293; AD-62263).

The equilibrium of a uniformly charged gas in a perfectly conducting container is studied. Equilibrium occurs when the electric forces in the gas just balance the pressure forces. It is found that for any container and for each total mass of gas there is exactly one equilibrium distribution of that mass of gas in the container. In equilibrium the density and pressure attain their maxima at the container surface, and they are both constant on this surface. Furthermore, the density and pressure increase at each point as the total mass of gas increases. However, inside the container the density and pressure do not increase indefinitely as the total mass of gas does. Instead at each inner point the density and pressure both approach finite upper limits as the total mass of gas becomes infinite. Most of the gas accumulates in a thin layer near the surface when the total mass is large. The fact that the density and pressure cannot be made arbitrarily large at inner points by putting more gas into the container is considered to be the main physically interesting result. (auth)

15149 MURA-567

Midwestern Universities Research Assn., Madison, Wis.
SCHWARZ-CHRISTOFFEL TRANSFORMATIONS PERTAIN-
ING TO MAGNET EDGES OR PEELERS. L. Jackson
Laslett. Apr. 5, 1960. 17p. Contract AT(11-1)-384.
OTS.

Schwarz-Christoffel transformations pertaining to the following two-dimensional electrostatic or magnetostatic situations are presented and simple formulas given for the consequent field in the median plane: thin, parallel electrodes; thick, parallel poles; step poles; neighboring, opposed magnet poles; and field between parallel poles in the presence of a magnetic shunt. Graphs are given to illustrate, in representative cases, the spatial variation of the median-plane field in these various situations. (auth)

15150 NASA-TN-D-275

National Aeronautics and Space Administration. Lewis
Research Center, Cleveland.

COMPILATION OF THERMODYNAMIC PROPERTIES,
TRANSPORT PROPERTIES, AND THEORETICAL
ROCKET PERFORMANCE OF GASEOUS HYDROGEN.
Charles R. King. Apr. 1960. 72p. OTS.

Data were computed assuming equilibrium composition during an isentropic expansion using normal hydrogen as the propellant for chamber pressures from 0.146960 to 1469.60 lb/sq in. abs, pressure ratios from 1 to 3000, and chamber temperatures from 600 to 5000°K. Computed parameters are nozzle-exit pressure and temperature,

enthalpy, molecular weight, isentropic exponent, specific heat at constant pressure, absolute viscosity, thermal conductivity, Mach number, specific impulse in vacuum, ratio of nozzle-exit to throat areas, thrust coefficient, specific impulse, equilibrium gas composition, characteristic velocity, and entropy. Additional data show some of the properties of gaseous normal hydrogen, orthohydrogen, and parahydrogen at temperatures below 600°K for several pressures. (auth)

15151 NP-8598

Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif.

ELECTRICAL SPACE PROPULSION. R. H. Boden. [1960]. 98p.

An evaluation of the technical and scientific status of present electrical propulsion is presented. The technical possibilities and growth potential of relevant propulsion and power generation systems during the period from 1960 to 1975 are also examined along with the propulsion needs based on mission requirements. Most of the electrical rocket systems are considered. (J.R.D.)

15152 NP-8600

Massachusetts Inst. of Tech., Cambridge. Solid-State and Molecular Theory Group.

QUARTERLY PROGRESS REPORT NO. 36. Apr. 15, 1960. 36p. Contract Nonr-1841(34).

Standing spin waves in crystals were observed experimentally, with wavelengths determined by boundary conditions arising from the finite size of the crystal. The general case is treated in which the direction of spin orientation instead of being fixed throughout the crystal varies according to the assumed spin wave. The Hartree-Fock equations for this more general case are formulated. Work is reported on iron group atoms containing two 4s electrons. The 3d electrons in an iron group atom with a 4s shell have wave functions practically identical to what they would be in the ion formed by removing the two 4s electrons. Progress is reported on computer programming and operation, energy bands, and molecular integrals and molecular calculations. (For preceding period see NP-8338.) (W.D.M.)

15153 NP-8634

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems.

π^- STAR DETECTOR. A. F. Dunaitzev, Yu. D. Prokoshkin, and Syao-wei (Syao-vay) Tang. 1960. 17p. (D-468)

A scintillation detector possessing selective sensitivity π^- meson stars is described. Pulse spectra, efficiency, selection characteristics of the detector, and modifications of the detector are discussed. (W.D.M.)

15154 NP-8636

Convair, San Diego, Calif.

PHYSICS SECTION QUARTERLY ACTIVITY REPORT. Apr. 1, 1960. 31p.

The status of research projects is briefly summarized in the fields of physical mechanics, theoretical molecular and plasma physics, solid state and physical electronics, experimental infrared, molecular beam, SPAD project, and nuclear and high energy radiations. (W.D.M.)

15155 NP-8641

Westinghouse Electric Corp. Research Labs., Pittsburgh. SOME ASPECTS OF THERMIONIC ENERGY CONVERSION. Scientific Paper 6-40602-3-P3. E. I. Blount. Mar. 20, 1959. 56p.

A general description of the operation of a thermionic device is given and operation at maximum power and ef-

iciency is analyzed. The various modes in which diodes achieve these conditions are discussed. The effect of leads in reducing efficiency is discussed. Two simple special cases are considered and some graphs applicable to one of them are given. The analogy with thermoelectric devices is discussed in considerable detail. (W.D.M.)

15156 NP-8658

Princeton Univ., N. J. Forrestal Research Center.

PROJECT SQUID. SUPPLEMENT "B." BIBLIOGRAPHY OF UNCLASSIFIED SQUID PUBLICATIONS FOR JULY 1, 1957 TO JUNE 1, 1959. Technical Report PR-67-P-B. 21p. Contract Nonr1858(25), NR-098-038.

A second supplement to a bibliography on Ten Years of Project Squid—A Bibliography is presented. All of the listed papers appeared as Squid reports dated later than June 1, 1957. (J.R.D.)

15157 NRL-5462

Naval Research Lab., Washington, D. C.

A STANDARD SOURCE OF RADIATION FOR RADIAC DETECTORS. II. EXTENSION OF THE RANGE OF EXPOSURE-DOSE RATES AND THE NEW Cs-137 SOURCE. A. E. Nash and W. E. Kunz. Feb. 4, 1960. 14p. Project No. NE-051-500-2.1.

Four facilities of similar design to produce standard gamma-ray fields have been constructed and calibrated at the U. S. Naval Research Laboratory for use with cobalt-60 and cesium-137 sources. These facilities provide four intensity ranges, two of which, the low and the medium ranges have previously been described and calibrated. The low range covers the region between background and 0.5 r/hr using interchangeable sources of Co-60, Cs-137, and Ra. The medium range, using Co-60, extends the field to 50 r/hr. The two new higher ranges extend the exposure-dose rate for the Co-60 source (150 curies) in one case and introduce a new source of Cs-137 (100 curies) in the other. The range of calibrated gamma-ray intensity now includes the region from background to over 2000 r/hr for Co-60 and to 800 r/hr for Cs-137. In addition to the calibration of the two new facilities, the older medium range has been recalibrated using a carbon ionization chamber, for which a calibration procedure has been adapted from a standard procedure. The two new sources are being used in conjunction with the new 300-kev x ray facility at NRL to provide energy calibration points for energy-dependence measurements. (auth)

15158 SCTM-72-60(34)

Sandia Corp., Albuquerque, N. Mex.

AN ANALYSIS OF GENERAL STORES INVESTMENT. R. M. Allan and P. H. Arnold. Mar. 7, 1960. 51p. OTS.

A project was undertaken to determine if there is a method of ordering control that could economically alleviate a chronic stock outage condition in General Stores stocks and reduce total procurement and carrying costs. An IBM 705 Electronic Data Processing System was employed to analyze various statistical methods that were available for improving inventory control and to provide results from a mathematical model which could be used to evaluate the effects of contemplated changes in policies and practices on inventory investments and associated expenses. (auth)

15159 TID-5821

Illinois. Univ., Urbana. Electrical Engineering Research Lab.

RESEARCH AND INVESTIGATION LEADING TO METHODS OF GENERATING AND DETECTING RADIATION IN THE 100 TO 1000 MICRON WAVELENGTH RANGE OF THE SPECTRUM. Quarterly Progress Report No. 16 [for]

Period Covered December 1, 1959 to March 1, 1960.

P. D. Coleman, W. L. Emery, A. W. Swago, J. Baird, B. Hakki, and J. Stafford. Apr. 1, 1960. 90p. Contract AT(11-1)-392. OTS.

Further work on experimentally testing the theory of a plasma frequency multiplier indicated that for the multiplier geometry now employed, quantitative predictions can be made on the behavior of the device. A plasma resonator, using electromagnetic, dipolar modes, appeared to possess very desirable properties as indicated by the computed mode charts. Work was initiated on three schemes of producing the uniform plasma column required in the study of polarization modes in a gyromagnetic plasma. The Cherenkov effect was considered in a gyromagnetic plasma, a dielectric tube resonator, and a dipolar plasma resonator. A brief summary of the over-all component development and evaluation program is included. (For preceding period see AECU-4661.) (W.D.M.)

15160 UCRL-5630-T

California. Univ., Livermore. Lawrence Radiation Lab. AIR CORE CRYOGENIC MAGNET COILS FOR FUSION RESEARCH AND HIGH ENERGY NUCLEAR PHYSICS APPLICATIONS. R. F. Post and C. E. Taylor. Oct. 30, 1959. 31p. OTS.

It is shown that cryogenic techniques offer the possibility of substantially improving the efficiency and practicality of generating high magnetic fields in air-core coils of large size. Over-all reductions in power requirements of as high as 25, by comparison with conventional coils, are predicted, provided high purity conductors and efficient refrigeration cycles are used. (W.D.M.)

15161 UCRL-5695-T

California. Univ., Livermore. Lawrence Radiation Lab. IONIZATION EQUILIBRIUM EQUATION OF STATE. PART I. SOLUTION OF EQUATIONS. Carl A. Rouse. Oct. 5, 1959. 11p. Contract W-7405-eng-48. OTS.

A simple solution to Saha's equation was obtained. The method of solution involves iteration with respect to the electron pressure or concentration and can be applied to the simultaneous calculations of any number of ions. Sample results are given for lithium and aluminum. (auth)

15162 UCRL-5961-T

California. Univ., Livermore. Lawrence Radiation Lab. ON THE ESTABLISHMENT OF A TEMPERATURE FUNCTION. W. Aron and L. Parker. [1960]. 9p. Contract [W-7405-eng-48]. OTS.

The relations among the thermodynamic variables which include temperature (T), energy per unit mass (E), volume per unit mass (V) and pressure (P) are examined, with the emphasis on the two functions P(V,E) and T(V,E). Illustrative cases such as that of a perfect gas, and that of a model representing a real substance are included. (J.R.D.)

15163 WADC-TN-59-180

Wright Air Development Center. Aeronautical Accessories Lab., Wright-Patterson AFB, Ohio. WEIGHT OPTIMIZATION OF A SOLAR OR NUCLEAR MECHANICAL CONVERSION SYSTEM. Leon Schipper. June 1959. 56p. Project title: ENERGY CONVERSION TECHNOLOGY.

Energy conversion systems for spacecraft must provide required power with minimum weight. Parameters are investigated for obtaining optimum weight. Efficiency of a component, group of components, or the entire system is important only insofar as it minimizes over-all system size and weight. Basic parameters are established for a solar-powered system and specific values assigned. The

effect of varying parameters contributing to efficiency vs. system weight is noted. The variables contributing most to system size and weight are collector and radiator. For a nuclear-powered system, the radiator provides the only possibility for significantly reducing weight. By properly matching the parameters affecting the power-producing unit with parameters affecting the heat-rejecting unit, optimum system weight can be achieved. (auth)

15164 WT-511

Air Force Cambridge Research Center. Terrestrial Sciences Lab., Mass.

THE MEASUREMENT OF FREE AIR ATOMIC BLAST PRESSURES. Norman A. Haskell and James O. Vann. Feb. 1953. Decl. Dec. 3, 1959. 59p. Project 1.1 of OPERATION SNAPPER. OTS.

Shock overpressure as a function of time was measured by utilizing an array of parachute-borne pressure gages spread over a wide range of distances and altitudes above two atomic detonations. The data were telemetered from the balloons and recorded at a ground station. Three multiple object tracking stations were used to locate the position of each parachute. The observed peak overpressures covering the range from about 0.1 to 3.0 psi confirmed existing theory on the effect of altitude on shock overpressure to within practical accuracy requirements and supplemented other free-air peak overpressure measurements which were made at higher overpressures by other methods. Meteorological data for Snapper Bursts 2 and 5 are given. Recommendations for future tests are included in the report. (auth)

15165 WT-715

Air Force Cambridge Research Center. Terrestrial Sciences Lab., Mass.

FREE-AIR ATOMIC BLAST PRESSURE MEASUREMENTS. Norman A. Haskell and Richard M. Brubaker. Apr. 1954. Decl. Nov. 10, 1959. 60p. Project 1.3 of OPERATION UPSHOT-KNOTHOLE. OTS.

Studies were made to determine the free-air peak overpressure vs. distance curve for air bursts at overpressure below those covered by existing data, the path of the triple point at high altitudes, and the relative strengths of the free-air and reflected shocks above the triple point and of the Mach shock below the triple point. The free-air values have been normalized to 1 KT in a homogeneous sea-level atmosphere and used to extend the Tumbler composite free-air curve down to overpressures of ~0.97 psi. A comparison of this curve with the results of previous tests at low heights of burst has been made to determine the effective reflection factor for these earlier shots. Some tentative conclusions were reached on the distribution of peak overpressures in the reflected and Mach shocks in the neighborhood of the triple point. (auth)

15166

SOME PROBLEMS HAVING REFERENCE TO THE CATHODE REGION OF LUMINESCENT DISCHARGE. E. Bădărău and I. Popescu. Acad. rep. populare Romîne, Inst. fiz. atomică și Inst. fiz. Studii cercetări fiz. 10, 689-732 (1959). (In Rumanian)

A synthesis of experimental and theoretical results from the study of the phenomena connected with the cathode region of luminescent discharge is presented. In the first part the kinetics of positive ions in their own gas is discussed. The role of resonance transfer in the kinetic processes is made clear. The mechanism of the cathode region is directly considered in the second part. The relations between the various specific quantities in the discharge are derived. The general characteristics of the

discharge are tabulated. The method of generalizing the relations obtained in order to apply them to the quantitative explanation of the normal region of luminescent discharge is indicated. 120 references. (J.S.R.)

15167

SOME OXYGEN IONS FORMED AT HIGH PRESSURES IN A MASS SPECTROMETER. William McGowan and Larkin Kerwin (Laval Univ., Quebec). Can. J. Phys. **38**, 642-51(1960) May.

The oxygen ions formed by electron bombardment and collision processes in the mass spectrometer at pressures of about 10^{-3} mm Hg are examined. Mass spectrum lines due to O^+ , O_2^+ , O_3^+ , and O_2^{2+} as well as Aston bands due to O^+ , O_2^+ , and O_2^{2+} are found. Processes leading to these species, as well as abundances and appearance potentials, are considered. (auth)

15168

ATOMIC RADIUS OF ELEMENTS. ELEMENTS CHARACTERIZED BY THEIR s AND p ELECTRONS OF THE 1, 2, 3, AND 4 EXTERNAL SHELLS. Rose Aynard. Compt. rend. **250**, 2683-5(1960) Apr. 11. (In French)

The function $r = f(s, p)$ is established and the parameters are defined on the basis of the element classification previously described (Compt. rend. **248**, 2165(1959)) and on the assumptions that the radius of free atoms varies as a function of the successive filling of the external shells 1 to 4, increasing by their s and p electrons only. A series function was then obtained. The radius of He is obtained by developing in series the arithmetic mean of r_1 . It is understood that these functions have no physical reality. (J.S.R.)

15169

ANISOTROPY OF THE LANDÉ FACTOR OF YTTERBIUM IN A GALLATE OF THE GARNET TYPE. Yves Ayant and Jean Thomas. Compt. rend. **250**, 2688-90(1960) Apr. 11. (In French)

In order to interpret the experimentally established anisotropy of the Landé factor of the Yb ion in gallate, the hamiltonian of the ion in the crystalline field was determined by taking account of the variation to the cubic symmetry in the vicinity of the oxygen atom. (tr-auth)

15170

ATOMIC RADIUS OF ELEMENTS. ELEMENTS CHARACTERIZED BY THEIR d AND f ELECTRONS OF INTERNAL SHELLS (3 TO 7). Rose Aynard. Compt. rend. **250**, 2804-6(1960) Apr. 20. (In French)

The function $r' = g(d, f)$ is established and its parameters are defined on the basis of the element classification previously reported (Compt. rend. **248**, 2165(1959)) and on the assumption that the atomic radius of the elements, characterized by their d and f electrons of the internal shell 3 to 7, varies as a function of the successive filling of these shells filled by their d and f electrons only. r' is the atomic radius of all the elements from 21 to 113 growing by these electrons only. The results showed that one can obtain all the atomic radii of the elements from 1 to 113 either as a function of their s and p electrons of the external shells 1 to 4 or as a function of their d and f electrons of the internal shells 3 to 7. (J.S.R.)

15171

TEMPERATURE MEASUREMENT AT THE DETONATION FRONT OF EXPLOSIVES. I. M. Voskoboïnikov and A. Ya. Apin (Inst. of Chemical Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. **130**, 804-6(1960) Feb. 1. (In Russian)

Electron-optical measurements were made of the

detonation front temperatures from liquid and solid explosives. (R.V.J.)

15172

FACTORS WHICH WILL INFLUENCE EARLY APPLICATION OF NUCLEAR ROCKETS. H. R. Schmidt and R. S. Decker (Atomic Energy Commission, Washington, D. C.). IRE Trans. Nuclear Sci. **NS-7**, 6-12(1960) Mar.

The potential performance which nuclear rockets may provide is illustrated. Many of the practical problems involved in nuclear rocket development are reviewed to provide an appreciation of the effort required. (auth)

15173

THE POSSIBLE PRESENCE OF BORON, SODIUM, AND POTASSIUM IN α ACTIVE SOURCES DEPOSITED ON HEAVY METALS. Marie Ader (Collège de France, Paris). J. phys. radium **21**, 102-4(1960) Feb. (In French)

Radioactive sources of Po, Pu, Th, and Ac emit, in addition to the α rays, three groups of particles, lighter than the α ones, and which have a maximum range of about 340μ in photographic emulsion. Former researches showed that these light particles come neither from the gases of the ambient atmosphere, the source holder, nor from contamination by other radioactive substances or Al. The proton spectra obtained by action of α rays of Po on boron, sodium, and potassium compounds are plotted. Comparison between these spectra and those of abnormally long-range particles emitted by the Po source removes the hypothesis of contamination of that source by boron, sodium, or potassium compounds. (auth)

15174

THE GREEN AND BLUE EMISSION BANDS OF $ZnS(Cu)$. G. Curie and D. Curie (Faculté des Sciences, Paris). J. phys. radium **21**, 127-9(1960) Feb. (In French)

It is suggested, at least as a first approximation, that the same fundamental level plays its part in both the "blue centers" and "green centers" of $ZnS(Cu)$. The emitted light quantum depends on the excited level "associated" with the fundamental level; the transition occurs between these two states. Experimental arguments are given supporting this model, especially resulting from electroluminescence studies. (auth)

15175

EXPERIMENT CARRIED OUT WITH A WILSON CHAMBER. J. phys. radium **21**, 17S-18S(1960) Feb. (In French)

A Wilson cloud chamber used with the Saturne for the study of the decay processes of a long-lived heavy meson, the K_2^0 , is described. The chamber itself is of a classical parallelepiped construction with vertical front glass and vertical piston. The installation is shown schematically, and the synchronization with the accelerator is described. The preliminary results obtained are discussed briefly. (J.S.R.)

15176

EXPERIENCES WITH COUNTERS AT THE SATURNE. M. G. Valladas (Centre d'Études Nucléaires, Saclay, France). J. phys. radium **21**, 24S-9S(1960) Feb. (In French)

The state of advancement of the counter technology at Saturne is shown by a description of the apparatus used in the measurement of the total cross section of π -nucleon interactions and in a study of K^+ production. The construction and properties of the scintillators and the associated electronics used in the cross section study are described. The design approach for the apparatus in the investigation of K^+ production is described. (J.S.R.)

15177

THE RADIOACTIVITY OF INDUSTRIAL GLASSES.

H. Gebauer (Firma Frieseke & Hoepfner GmbH, Erlangen-Bruck, Ger.). *Kerntechnik* **2**, 121-3(1960) Apr. (In German)

The radioactivity of various glasses was investigated, and the automatic measuring equipment used in the study is described. The radioactivity of the glasses was determined principally from the K_2O content, especially from the content of the K^{40} isotope. The measurements gave values between 0 and 107 pulses/min-g. The results were discussed with respect to the utilization of single glass types in counter tube technology. (tr-auth)

15178

NEUTRON DIFFRACTION AND STRUCTURE STUDIES IN

KJELLER. J. A. Goedkoop and B. O. Loopstra (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). *Ned. Tijdschr. Natuurk.* **25**, 29-41(1959) Feb. (In Dutch)

After a brief description of the apparatus used, a survey is given of the work done at Kjeller on the determination of atomic sites in crystals. Structure determination by the Debye-Scherrer method and the single crystal method is discussed. (J.S.R.)

15179

RELATION BETWEEN INELASTIC NEUTRON SCATTERING AND THERMODYNAMIC FUNCTIONS OF LIQUID HELIUM. Michael Cohen (Univ. of Pennsylvania, Philadelphia). *Phys. Rev.* **118**, 27-41(1960) Apr. 1.

A model of liquid helium is analyzed in which the liquid is regarded as a collection of excitations ("rotons" only with energy $\geq \Delta$) with an arbitrary pairwise number-conserving interaction. The entropy and normal fluid density of the liquid and the energy distribution of scattered neutrons are computed as power series in the density of excitations $\exp(-\Delta/kT)$. The first terms containing effects of the interactions are studied. When the interactions are weak, the entropy [through order $\exp(-2\Delta/kT)$] is simply related to the neutron scattering, the connection being correctly given by the formula of Bendt, Cowan, and Yarnell. For strong interactions there appears to be no simple connection. Even when interactions are weak, the first correction to the normal fluid density involves information which is not contained in the neutron scattering. A method due to Bloch and de Dominicis is used in the analysis, and leads to a new form for the second virial coefficient. This is closely related to a curious new form for the level shift of a particle in a large spherical box under the influence of a central potential. (auth)

15180

NEUTRON DIFFRACTION STUDY OF THE MAGNETIC PROPERTIES OF RARE-EARTH-IRON PEROVSKITES.

W. C. Koehler, E. O. Wollan, and M. K. Wilkinson (Oak Ridge National Lab., Tenn.). *Phys. Rev.* **118**, 58-70(1960) Apr. 1.

A neutron diffraction study was made of the magnetic properties of the rare-earth-iron perovskites, $NdFeO_3$, $HoFeO_3$, and $ErFeO_3$, at temperatures ranging from 955 to 1.25°K. The iron ions in each of these compounds undergo a transition to an antiferromagnetic configuration in which each moment has six oppositely directed moments at nearest neighbor distances. The Néel temperatures are 760, 700, and 620°K for the compounds of Nd, Ho, and Er, respectively. The moment directions in $HoFeO_3$ and $ErFeO_3$ are parallel and antiparallel to the orthorhombic [100] direction at room temperature; at 43°K the moments are

found to be in a $(\bar{1}10)$ plane. In $HoFeO_3$ the iron-ion moments at 1.25°K are parallel to [001]; in $ErFeO_3$ at the same temperature they are parallel to [110]. The magnitudes of the ordered iron moments at temperature saturation are 4.57, 4.60, and 4.62 Bohr magnetons in $NdFeO_3$, $HoFeO_3$, and $ErFeO_3$, respectively. In the liquid helium temperature range, magnetic ordering transitions of the rare-earth ions in $HoFeO_3$ ($T_N = 6.5^\circ K$) and $ErFeO_3$ ($T_N = 4.3^\circ K$) are observed. The Er^{3+} ion moments form a nearly ideal antiferromagnetic configuration in which a chain of parallel moments is surrounded by four chains of oppositely directed moments at nearest neighbor distances. In this compound the Er^{3+} ion moments are parallel and antiparallel to [001] and at 1.25°K have a magnitude of 5.8 Bohr magnetons. In $HoFeO_3$ the ions are ordered in a distorted antiferromagnetic configuration in which, at 1.25°K, each Ho^{3+} moment with magnitude of 7.5 Bohr magnetons, makes an angle, in the (001) plane, of about 27° with the [010] direction so as to produce a net ferromagnetic moment of 3.4 Bohr magnetons per $HoFeO_3$ molecule parallel to [100]. (auth)

15181

PARAMAGNETIC RESONANCE OF IMPURITIES IN $CaWO_4$.

I. TWO S-STATE IONS. C. F. Hempstead and K. D. Bowers (Bell Telephone Labs., Murray Hill, N. J.). *Phys. Rev.* **118**, 131-4(1960) Apr. 1.

Paramagnetic resonance measurements were made on Mn^{+2} and Gd^{+3} ions in single crystals of $CaWO_4$ grown from the melt. In both cases the four different possible substitutional sites in the unit cell lead to identical resonance spectra with tetragonal symmetry. The splitting of the electronic levels in zero magnetic field is much greater for Gd^{+3} than for Mn^{+2} , e.g., b_2^0 is 6.7 times greater and b_4^0 is 13 times greater. (b_n^m is the coefficient of an operator function having the same transformation properties as the corresponding spherical harmonic Y_n^m used in expanding the crystalline electric field.) The large value of b_2^0 (-0.0917 cm^{-1}) for Gd^{+3} makes it a potentially useful material for three-level masers. The lines are narrow, and the hfs due to $Gd^{155,157}$ is well resolved; the ratio A^{155}/A^{157} of the hyperfine splitting constants for the two isotopes was determined as 0.763 ± 0.006 . (auth)

15182

 H_1^+ PRODUCTION BY HYDROGEN POSITIVE ION BOMBARDMENT OF A TUNGSTEN SURFACE.

L. P. Levine and H. W. Berry (Syracuse Univ., N. Y.). *Phys. Rev.* **118**, 158-66(1960) Apr. 1.

A study of the energy distribution of the negative ions was made using one-kilovolt ions. The double mass spectrograph used allows analysis of both the incoming positive- and outgoing negative-ion beams. Two peaks are studied: a low-energy peak of negative hydrogen ions created by the bombardment of a dirty surface by an assortment of positive ions, and a high-energy peak of negative hydrogen ions created only under bombardment of a surface by H_1^+ and H_1^+ . The height of the low-energy peak is found to be proportional to the amount of hydrogen on the surface. The curve has a peak three volts wide at its half-maximum, and a tail 25 volts long on the high self-energy side. The high-energy peak ranges from zero self-energy to a value resulting from a head-on collision between a proton in the incoming ion beam and one of the atoms in the surface. This curve is flat over its whole-energy range, dropping to zero at the low self-energy end independent of incident ion energy. On a clean surface the shape of this curve is independent of target temperature. The shape of the high-energy curve is compared with curves predicted

by a random walk-collision theory and a theory based on the loss and gain, due to scattering, of particles in velocity groups. The shape of the low-energy curve is compared with curves predicted by a theory of thermal desorption of ions from a surface coupled with a mechanism for neutralization of ions as they leave the surface. (auth)

15183

TRANSPORT PHENOMENA IN SLIGHTLY IONIZED GASES: HIGH ELECTRIC FIELDS. Mahendra Singh Sodha (Armour Research Foundation, Chicago). *Phys. Rev.* **118**, 378-81(1960) Apr. 15.

Starting with the electron velocity distribution obtained by Chapman and Cowling for a Lorentzian gas, in the presence of an electric field, the author has investigated the variation with electric field of a number of transport properties, arising from a magnetic field, perpendicular to the electric field and temperature gradient in the gas. The applicability of the results to semiconductors has also been pointed out. A constant mean free path has been assumed, which is validated by experiments for helium. (auth)

15184

PULSED NUCLEAR RESONANCE SPECTROSCOPY. M. Emshwiler, E. L. Hahn, and D. Kaplan (Univ. of California, Berkeley). *Phys. Rev.* **118**, 414-24(1960) Apr. 15.

A technique for the detection of weak nuclear resonance interactions in solids is carried out by a pulsed method which obtains nuclear double resonance. The resonance of the unknown species to be detected does not require a Boltzmann population difference in spin orientation, but must have a sufficient dipole-dipole interaction with a second spin species. At resonance, a single 180° pulse reorients the unknown spins at the time of the 180° pulse in the 90 to 180° pulse sequence necessary to obtain the observed spin-echo signal of the second species. A reduction of the spin-echo signal signifies double resonance due to changes in local dipolar fields, coupled to the observed spins, which scrambles their precessional phases. Nuclear quadrupole coupling interactions of K, Cs, and Rb isotopes are measured in the chlorates of these ions, where the Cl^{35} nucleus provides the observed nuclear quadrupole echo. An analysis is presented for the case of low concentration of unknown spin species. Double quantum transitions and special properties of nuclear quadrupole spectra are observed. (auth)

15185

RELATIVISTIC SELF-CONSISTENT SOLUTIONS FOR ATOMS OF LARGE ATOMIC NUMBER. Stanley Cohen (RAND Corp., Santa Monica, Calif. and Univ. of California, Berkeley). *Phys. Rev.* **118**, 489-94(1960) Apr. 15.

Relativistic self-consistent solutions, without exchange, have been obtained for several atoms of large atomic number by use of a general program for a high speed computing machine. A short description of this program and of the self-consistent calculation is given. Eigenvalues for the individual electron subshells of the self-consistent mercury, tungsten, platinum, and uranium atoms are presented. A comparison of the calculation with previous results for the mercury atom is also included. (auth)

15186

INVESTIGATIONS ON PARTICLE COLLISIONS AT ENERGIES FROM 6 TO 30 kev. Rudolf Hölz (Universität, Glessen, Ger.). *Z. Naturforsch.* **15a**, 211-19(1960) Mar. (In German)

In the investigation of the kinetic energy transferred

in ion collisions, the direction of hydrogen, helium, and neon ions in light and heavy hydrogen was measured against the differential ionization of the gases in the energy range from 6 to 30 kev. In the lower energy range, it is slightly larger (the transferred kinetic energy is therefore smaller) for all projectile masses in deuterium than in hydrogen. With increasing collision velocities, this ratio for the heavy ions is reversed which is explained by the angular scattering. The agreement with theory is satisfactory: the orders of magnitude and mass dependence of the transferring kinetic energy corresponds to the idea introduced by Bohr (1948) that the elastic interaction depends on the electrostatic repulsion of the collision partner penetrating relatively little at this energy range. Thus, the transferred pulse is dependent on the atomic number, but in the first approximation is independent of the mass of the collision partner. Then results the experimentally confirmed mass dependence of the energy released by the particles: the braking is smaller in the heavy gas than in the light. (tr-auth)

15187

A THERMAL ION SOURCE FOR LITHIUM. K. Habfast (Institut für Bodenkunde, Munich). *Z. Naturforsch.* **15a**, 273-4(1960) Mar. (In German)

For a thermal ion source with good ion yield, constant evaporation, no memory effect, and low fractionation, the evaporation zone must be at some distance from the ionization filament and the Li vapor must be conducted through a small tube to the ionization filament. The design and performance of such a source for lithium ions are described. (J.S.R.)

15188

SINGLE DETECTION OF ELECTRONS (15 TO 50 KEV) IN NUCLEAR PHOTOPLATES. R. Wittekindt (Universität, Mainz). *Z. Physik* **158**, 572-6(1960). (In German)

Nuclear track emulsions (Ilford G 5) were used for counting single slow electrons. They had to be accelerated by high voltage of about 30 kv and were incident vertically. The pulsed electron beam was measured in a cage; single pulses were shot on the emulsion. The developed plates were photographed under the microscope and the tracks counted on the enlarged copies. The results are that about 40% of incoming electrons can be found as tracks in the emulsions. This number varies between different emulsions (of same type G 5); within one plate the number of tracks is more proportional to the number of electrons than between different plates. With a counting result x one may expect the true result under 90% security within $x \pm 2\sqrt{x}$. (auth)

15189

A NEW METHOD FOR INVESTIGATING MAGNETIC FIELDS FOR SECURING HIGH-ORDER FOCUSING. V. R. Saulit. *Vestnik Leningrad Univ., Ser. Fiz. i. Khim.* **15**, No. 4, 33-40(1960). (In Russian)

A new method for calculating a high-order focusing magnetic field is presented. The solution of the problem for an inhomogeneous field depending on one cartesian coordinate is found in the form of polynomials. The magnetic field thus obtained was proven to have continuous derivatives. One can obtain by this method electron- or ion-beams of desired forms. A magnetic field giving seventh-order focusing is calculated. (B.O.G.)

15190

ELECTRIC ENERGY SOURCES AND CONVERSION TECHNIQUES FOR SPACE VEHICLES. Volney C. Wilson (General Electric Research Lab., Schenectady, N. Y.). IAS

Paper No. 60-31. Presented at the IAS Annual Meeting, January 25-27, 1960, New York, New York. New York, Institute of the Aeronautical Sciences, 1960. 18p. \$1.00.

Methods of converting solar and atomic energy to electricity in satellites are reviewed. Estimates of the possible minimum weights in pounds per kilowatt for satellite electric supplies are given. The efficiency of a thermionic converter for one and two volts at 500 to 3000°K was evaluated. (C.J.G.)

15191

CHARGE TRANSFER IN ATOMIC AND MOLECULAR HYDROGEN. E. Gerjouy (General Atomic Div., General Dynamics Corp., San Diego, Calif.) and R. H. Bassel and T. F. Taun (Univ. of Pittsburgh). p.IA28-33 of "Proceedings of the Fourth International Conference on Ionization Phenomena in Gases, Uppsala, 17-21 August 1959." N. Robert Nilsson, ed. Amsterdam, North-Holland Publishing Company, 1960.

A distorted wave method, which removes the unphysical proton-proton interaction from the "perturbation" Hamiltonian, is applied to the atomic charge transfer reaction $p + H \rightarrow H + p$. In the energy range 35 to 200 kev, numerical results of a first order calculation yield total cross sections close to the more conventional first Born approximation estimates, in which the proton-proton interaction is retained in the perturbation; however, the distorted wave and Born estimates yield very different results for the variation of charge transfer probability with impact parameter. Furthermore, careful examination of the molecular charge transfer reaction $p + H_2 \rightarrow H + H_2^+$ discloses several important molecular effects which have no analogue in the atomic reaction, and which make suspect the customary assumption that at high energies one H_2 molecule is equivalent to two H atoms for purposes of charge transfer. For these reasons charge transfer at high energies cannot yet be considered well understood, despite the reasonably good agreement (with this assumption) between measured cross sections for the molecular reaction and predicted (first Born approximation) cross sections for the atomic reaction. (auth)

Cosmic Radiation

15192 NP-8649

Space Technology Labs., Inc. Electronic Lab., Los Angeles.

GEOPHYSICAL AND ASTROPHYSICAL STUDIES. COSMIC RAY EXPERIMENTS IN SPACE. John W. Lindner. Oct. 8, 1958. 12p. (GM-TM-0165-00303).

The physics of cosmic rays is discussed. A summary of rocket and satellite research on cosmic rays is given. Several types of cosmic radiation detection instruments are described. A series of space experiments suitable for performance in various types of space vehicles are described. (C.J.G.)

15193

CONCERNING THE PROBLEM OF THE NATURE OF SHOWERS PRODUCED IN LEAD BY THE PENETRATING COMPONENT OF COSMIC RADIATION. S. Alpar, E. Balea, E. Friedlander, and M. Mayer. Acad. rep. populare Romîne, Inst. fiz., Studii cercetări fiz. 9, No. 2, 175-80(1958). (Translated from Referat. Zhur. Fiz. No. 9, 1959, Abstract No. 19894).

A total of 2,988 hodoscopic photographs was investigated for the purpose of obtaining comparative data on the distribution of the multiplicity and the angles of soft particles of δ showers and electron-nuclear showers. It was

found that the angular divergence of the latter is considerably broader and can serve as an effective means of discrimination from δ showers in setups intended for the registration of nuclear interactions at high energy.

15194

ON THE AZIMUTHAL DISTRIBUTION OF MESON JETS. E. Balea, E. Friedländer, and C. Potoceanu. Acad. rep. populare Romîne, Inst. fiz. atomică și Inst. fiz. Studii cercetări fiz. 10, 413-16(1960). (In Rumanian)

The azimuthal distribution of secondaries in 22 p jets and 6 α and heavy primary-induced jets was investigated in Ilford G-5 stratosphere-flown plates. A significant deviation from uniformity was observed only on the proton-induced jets, in good agreement with the existence of a preferential plane defined by the directions of motion of the incoming nucleons before the collision. (auth)

15195

HIGH-ALTITUDE COSMIC RAY MEASUREMENTS AT FORT CHURCHILL. I. B. McDiarmid and D. C. Rose (National Research Council, Ottawa). Can. J. Phys. 38, 638-41(1960) May.

Measurements with rocket-borne Geiger counters were carried out at altitudes up to 250 km at Fort Churchill, Manitoba. The total primary cosmic ray intensity at a time near a solar maximum was determined and compared with other measurements taken at times of high solar activity and also with other Geiger counter measurements obtained near a solar minimum. A low-energy radiation was observed whose intensity increased with altitude up to about 25% of the primary intensity at 250 km. (auth)

15196

SEMI-CUBIC TELESCOPE OF COUNTERS FOR THE MEASUREMENT OF THE VARIATION OF THE INTENSITY OF COSMIC RADIATION UNDERGROUND IN ACCORDANCE WITH THE PROGRAM OF THE INTERNATIONAL GEO-PHYSICAL YEAR (PRELIMINARY RESULTS). Tamas Sandor, Antal Somogyi, and Forenc Telbisz. Magyar Tudományos Akad. Központi Fiz. Kutató Intézetének Közleményei 6, No. 3, 117-28(1958). (Translated from Referat. Zhur. Fiz. No. 9, 1959, Abstract No. 19898).

Registration of the variations of the intensity of cosmic radiation at a depth of approximately 40 meters water equivalent was carried out. For this purpose use was made of two identical semi-cubic telescopes operating independently of each other. On the basis of 18.5×10^6 coincidence events, registered from 20 February 1958 through 9 March 1958, a determination was made of the coefficients of absorption and of the decay of the hard components, which were found to equal respectively $(-0.58 \pm 0.04)\%$ mm⁻¹ mercury and $(-1.03 \pm 0.23)\%$ km⁻¹. An estimate was made of the instability of the operation of the telescope during that time, which was found to be approximately 0.3%. This instability may be attributed completely to the fluctuations of the dead time and the number of random coincidences, i.e., to the variation in the background of the apparatus.

15197

A RELATION BETWEEN SOLAR RADIO EMISSION AND POLAR CAP ABSORPTION OF COSMIC NOISE. M. R. Kundu and F. T. Haddock (Univ. of Michigan, Ann Arbor). Nature 186, 610-13(1960) May 21.

Results are reported from a statistical study of the nature of centimeter-wave as well as meter-wave radio outbursts associated with polar cap absorption events. General conclusions are drawn regarding the prediction of the proton events. (C.H.)

15198

EVIDENCE FOR A FORBUSH TYPE OF DECREASE IN THE INTENSITY OF HEAVY NUCLEI OF THE PRIMARY COSMIC RADIATION. S. Biswas, P. J. Lavakare, K. A. Neelakantan, and P. G. Shukla (Tata Inst. of Fundamental Research, Bombay). *Phys. Rev.* **118**, 591-3(1960) Apr. 15.

In an emulsion stack flown on March 13, 1956, from Iowa, the flux of heavy nuclei with $Z \geq 6$ in the primary cosmic radiation was measured as 15.8 ± 1.0 and 3.7 ± 0.6 particles/m² sec sr for particles of kinetic energy ≥ 0.23 and ≥ 1.55 Bev/nucleon, respectively. The measured flux of energy ≥ 1.55 Bev/nucleon was $57 \pm 11\%$ lower than the normal flux. It is shown that almost the entire part of the reduction must be attributed to a large Forbush decrease of the cosmic radiation that occurred at the same time. The exponent of the integral energy spectrum of heavy nuclei ($Z \geq 6$) was measured as 1.78 ± 0.24 in the energy interval 0.23 to 9 Bev/nucleon. As this value is not significantly different from its normally measured value, it appears that the large reduction in the primary flux was not accompanied by any significant change in the energy spectrum.

Elementary Particles and Radiations

15199 CERN-60-10

European Organization for Nuclear Research, Geneva. K-MESON PRODUCTION IN $N-\bar{N}$ ANNIHILATION COMPUTED WITH A STATISTICAL THEORY. F. Cerulus. Mar. 25, 1960. 7p.

It has been pointed out that a Fermi-type statistical theory could account reasonably well for the multiplicity and the spectra of pions observed in $p-\bar{p}$ and $\bar{p}-n$ annihilation at rest. In order to fit the experimental data with a normal interaction volume, a strong $\pi-\pi$ interaction in the final state is assumed. The same type of computation is applied to $p-\bar{p}$ and $\bar{p}-n$ annihilation events in which K-mesons are produced. The results are briefly summarized. (W.D.M.)

15200 MURA-563

Midwestern Universities Research Assn., Madison, Wis. SOME NOTES ON THE KINEMATICS OF HIGH ENERGY NUCLEON-NUCLEON COLLISIONS. S. P. Rosen. Mar. 2, 1960. 30p. Contract AT(11-1)-384. OTS.

The kinematics of high-energy nucleon-nucleon collisions are examined in the laboratory system and the rest-frame of the center-of-mass, and the appropriate Lorentz transformation is described in detail. Some of the results are applied to the production of pions and antinucleons. (auth)

15201 NP-8632

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

SOME CONSEQUENCES OF THE SYMMETRY OF THE UNIVERSAL FERMION WEAK INTERACTION. T. H. Ho and H. Y. Tzu. 1960. 11p. (E-456).

It is shown that the invariance of the universal V-A Fermi weak interaction with respect to the Fierz transformation forbids the μ^- meson being captured by the proton in the triplet S state. It also forbids the μ^- meson being captured by the proton in the singlet S state with the emission of one photon. It is shown further that the state of the two fermions or that of two anti-fermions produced in all weak interaction processes can be described by one wave function, if the effects of other interactions involving these two particles are neglected. In particular, the general functions describing the polarization correlation are given. The asymmetry in the angular distribution of the

neutron emitted by a nucleus after capturing a μ^- -meson is discussed. (auth)

15202 NP-8633

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

DISPERSION RELATION AND THE ANALYSIS OF THE ENERGY DEPENDENCE OF THE CROSS SECTION NEAR THE THRESHOLD FOR NEW REACTION. L. I. Lapidus and Kuang-chao Chou. 1960. 16p. (D-467)

Dispersion relations are applied to the analysis of energy dependence of the scattering amplitude near threshold for a new reaction. A general expression which characterizes the nonmonotonic energy dependence for the forward scattering amplitude is obtained. The energy dependence of the γ -d elastic scattering amplitude near threshold for photo-disintegration of the deuteron is discussed. (auth)

15203 NP-8665

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

POTENTIAL SCATTERING OF NEUTRONS FOR Fe, Co, Ni, Cu, Zn, Se. (Rozproszenie Potencjałowe Neutronów NA Fe, Co, Ni, Cu, Zn i Se). Report No. 131/I-A. W. Ratyński, J. Turkiewicz, and P. Zuprąński. Jan. 1960. 8p.

A method for estimation of potential cross sections for elements of the medium atomic weight region is described. Calculated cross sections of investigated elements and corresponding effective nuclear radii are included. (J.R.D.)

15204 UCRL-5913

California. Univ., Livermore. Lawrence Radiation Lab. NEUTRON DIFFUSION THEORY PROGRAMS AND THEIR APPLICATION TO SIMPLE CRITICAL SYSTEMS. Stuart P. Stone and Richard E. Lingenfelter. Mar. 1960. 35p. Contract W-7405-eng-48. OTS.

UCRL has developed a series of reactor neutronic programs for an IBM-709. A brief outline of these codes (9 ZOOM and 9 ANGIE) and the results of one- and two-dimensional diffusion calculations used to interpret data from a series of enriched uranium BeO moderated critical measurements are given. A series of codes, SOPHIST, is described which prepares neutronic data for the criticality codes. (W.D.M.)

15205

CONSIDERATIONS CONCERNING THE THEORY OF ELEMENTARY PARTICLES. A. LIMITS OF APPLICABILITY OF SEMICLASSICAL MODEL. Teofil T. Vescan. Acad. rep. populare Romîne, Filiala Iași, Științe stîinț., Fiz. stîințe tehnice 8, No. 2, 103-39(1957). (Translated from Referat. Zhur. Fiz. No. 9, 1959. Abstract No. 19614).

Describing the difficulties of modern theory of elementary particles, the possibility of using classical models of these particles for the description of particles is considered. A qualitative explanation is given of the various characteristics of elementary particles (mass, spin, etc.).

15206

MEAN LIVES OF POSITRONS IN ALUMINUM AND THE ALKALI METALS. R. E. Bell and M. H. Jørgensen (Univ. of Copenhagen). *Can. J. Phys.* **38**, 652-64(1960) May.

The time distribution of positron annihilations in the metals aluminum, lithium, sodium, potassium, and cesium were measured with a fast time-to-amplitude converter. The decay curves appear to be complex, with about 5% of the events having a mean life of approximately 5×10^{-10}

sec. The main (95%) components of the decay curves show the following mean lives, in units of 10^{-10} sec: Al, 1.9 ± 0.2 ; Li, 2.9 ± 0.2 ; Na, 3.15 ± 0.2 ; K, 4.0 ± 0.2 ; Cs, 4.3 ± 0.2 . The results for the alkali metals disagree with the previously published measurements of De Benedetti and Richings (1952). These results are discussed and the life-times for other metals are predicted roughly from them and from the angular correlation measurements of other workers. (auth)

15207

ASYMMETRIES IN THE BETA DECAY OF POLARIZED NEUTRONS. M. A. Clark and J. M. Robson (Atomic Energy of Canada Ltd., Chalk River, Ont.). *Can. J. Phys.* **38**, 693-5(1960) May.

The equation for the angular distribution of the products from decay of a polarized neutron into an antineutrino, an electron, and a proton was studied by determining coefficients B and D with coincidence asymmetry measurements (B is the coefficient of the correlation between the neutron spin and anti-neutrino direction, and D that of the correlation between the neutron spin and the electron-antineutrino interaction). B was determined to be $+0.96 \pm 0.40$, which is compared with the theoretical plot of B as a function of the vector and axial vector interaction ratio. D was determined to be -0.14 ± 0.20 , which is consistent with the assumption of time reversal invariance for the neutron decay. (D.L.C.)

15208

ALGEBRAIC THEORY OF MESONS AND BARYONS. Jean-Marie Souriau (Faculté des Sciences, Marseille). *Compt. rend.* **250**, 2807-9(1960) Apr. 20. (In French)

An isospace with seven dimensions is proposed in which the meson is a vector and the baryon is a spinor. A group with 21 parameters which conserves the strong interactions is deduced. Lagrangians are proposed for the strong and electromagnetic interactions. (tr-auth)

15209

μ -MESON DECAY AND THE NON-CONSERVATION OF PARITY. B. Jaksii and J. Soln. *Glasnik mat.-fiz. i Astron., Ser. II* **13**, No. 2, 125-37(1958). (Translated from *Referat. Zhur. Fiz.* No. 9, 1959, Abstract No. 19620).

The energy spectrum, angular distribution, and the polarization of electrons emitted in the decay of polarized mesons are calculated for the four-fermion interaction of general form under the assumption of an arbitrary degree of parity nonconservation in muon decay.

15210

THE BARYCENTER IN THE FUNCTIONAL THEORY OF PARTICLE SYSTEMS. Florence Aeschlimann (Institut Henri Poincaré, Paris). *J. phys. radium* **21**, 115-20 (1960) Feb. (In French)

A definition is given of the barycentric wave for a system of n particles in the functional theory, in the relativistic case, and in the non-relativistic case with spin and isospin or without spin. The equation for the barycentric wave in the relativistic case and in the non-relativistic case is derived. The case of particles of the same mass is considered. Motion around the barycenter is discussed, and equations for the relative motion are obtained. The particular case of a two-particle system is considered. (auth)

15211

MEASUREMENT OF THE TOTAL CROSS SECTION FOR THE INTERACTION OF CHARGED π MESONS WITH

PROTONS. *J. phys. radium* **21**, 158-16S(1960) Feb. (In French)

The experimental arrangement for measuring the attenuation of a beam of π mesons in liquid hydrogen is described. The energy of the beam was measured directly by curves of differential path of protons at 800 Mev/c, by curve of differential path of π^+ at 400 Mev/c, and by time-of-flight of the protons. The corrections for the contamination of the beam with μ mesons and electrons were determined to be 0.07 ± 0.03 at 1 Bev and 0.30 ± 0.03 at 400 Mev, respectively. (J.S.R.)

15212

ELASTIC SCATTERING OF π^- MESONS ON PROTONS AT THE FIRST RESONANCE $T = \frac{1}{2}$. M. J. Meyer (Centre d'Études Nucléaires, Saclay, France). *J. phys. radium* **21**, 18S-19S(1960) Feb. (In French)

The first results obtained at Saclay with a hydrogen bubble chamber in the study on the angular distribution of π^- mesons elastically scattered at 745 Mev/c are presented. The results are graphed and show a distribution slightly more backward and forward than previous experiments. (J.S.R.)

15213

USE OF A 16-LITER PROPANE BUBBLE CHAMBER. M. A. Rogozinski (Centre d'Études Nucléaires, Saclay, France). *J. phys. radium* **21**, 19S-21S(1960) Feb. (In French)

The propane bubble chamber is briefly described. The problem of the conservation of parity in a strong interaction was investigated by verifying if the decomposition products of Λ^0 , created by the interaction of π mesons with C nuclei, exhibit an input asymmetry with respect to the line of flight in the center-of-mass system of the hyperon. The asymmetry, if it exists, is small and was not detected in these experiments. Preliminary results on the production of the strange particles Σ^+ and K^+ from a (π^+, p) interaction show a production cross section of 0.1 to 0.2 mb. (J.S.R.)

15214

PROTONS FROM THE $p + d$ BREAKUP REACTION AT PROTON ENERGIES OF 14 Mev AND 10 Mev. Seishi Kikuchi, Junpei Sanada, Shigeki Suwa, Izuo Hayashi, Keigo Nisimura, and Kiyoji Fukunaga (Tokyo Univ.). *J. Phys. Soc. Japan* **15**, 749-53(1960) May. (In English)

The energy spectra of the protons from the $p + d$ breakup reaction as a function of angle were measured for the incident proton energies of 13.9 and 10.1 Mev, using a particle selecting counter telescope consisting of a three- or five-layer proportional counter for the energy loss measurement and of a NaI scintillation counter for the energy measurement. Each of the observed energy spectra shows a rather steep rise at the maximum energy followed by a slight shoulder at large angles at the incident proton energy of 14 Mev, while the energy spectra at small angles do not show such shoulder. For both energies, each of the spectra has a maximum in its low energy side. (auth)

15215

MAGNETIC SCATTERING OF NEUTRONS. Tormod Riste (Joint Establishment for Nuclear Energy Research, Kjeller, Norway). *Ned. Tijdschr. Natuurk.* **25**, 42-51(1959) Feb. (In English)

Superposed on the neutron diffraction pattern of discrete peaks obtained with crystalline magnetic substances, there is a contribution caused by neutrons which are scattered magnetically by the atoms. This magnetic scattering is characterized by the angular dependence of the scattering

and its dependence on the direction of the moments that scatter. The separation of the two components is discussed. The technique used in the study of magnetic scattering and the results obtained in various studies are reviewed. 20 references. (J.S.R.)

15216

QUANTUM STATISTICS OF INTERACTING PARTICLES; THERMODYNAMIC QUANTITIES AND PAIR DISTRIBUTION FUNCTION. S. Fujita and R. Hirota (Northwestern Univ., Evanston, Ill.). Phys. Rev. **118**, 6-26(1960) Apr. 1.

An alternative approach to the quantum statistics of interacting particles is proposed. It consists of calculating the equilibrium thermodynamical quantities of the many-body system via the pair distribution function with the assumption that the particles interact with each other only through pair central forces. The proposed approach has some advantage over the usual treatment via the partition function in that the pair distribution function is easier to deal with than the partition function in certain circumstances particularly when the collective motion description of the system is desirable. This is because only the pair distribution function can be expressed directly in terms of the collective interaction which is closely connected with collective elementary excitation, such as a plasmon in the electron gas and a phonon in the hard-sphere Boson gas. The equation of state as well as the internal energy are obtained in the form of integrals of the pair distribution function. The close analogy between the pair distribution function and the two-body propagator, which appears in the quantum field theory, makes it possible to analyze the former by the use of Feynman diagrams identical with those usually introduced for the latter. The collective interaction, which is defined by the sum of the direct and the indirect interactions, is introduced as a particular partial sum of the perturbation series of the pair distribution function. This is used in rewriting the pair distribution function in terms of the collective interaction. It is shown that, while the simple chain approximation to the collective interaction in the electron gas is responsible for the transfer of a plasmon, the same approximation to the collective pseudo-interaction in the hard-sphere Boson system has a relation similar to that of transfer of a phonon, both cases occurring at low temperatures. The explicit calculation of the pair distribution functions for these systems at the absolute zero temperature is carried out up to the first order in the collective interaction (simple chain approximation). These results are used to calculate the ground-state energies. For the electron gas the energy thus obtained confirms Gell-Mann-Brueckner's calculation of the correlation energy. For the hard-sphere Bosons the calculated energy reproduces the result of Lee, Huang, and Yang. The extension of the calculation to the finite temperature case is also indicated. In particular the classical Debye-Huckel equation of state for the electron gas is briefly discussed. (auth)

15217

GROUND-STATE ENERGY OF A MANY-FERMION SYSTEM. W. Kohn (Carnegie Inst. of Tech., Pittsburgh) and J. M. Luttinger (Univ. of Pennsylvania, Philadelphia). Phys. Rev. **118**, 41-5(1960) Apr. 1.

The Brueckner-Goldstone perturbation series for the ground-state energy of an interacting gas of fermions is criticized. This energy is calculated by first constructing the grand partition function at finite temperature, and then carefully taking the limit as $T \rightarrow 0$. In general this leads to a series which differs from that of Brueckner and Goldstone. An exception is the case where both the unperturbed

single-particle energy and the interaction potential have spherical symmetry. Reasons for the breakdown of the Brueckner-Goldstone formalism are briefly discussed. (auth)

15218

ELECTRON-HYDROGEN SCATTERING AT LOW ENERGIES. Takashi Ohmura and Haruko Ohmura (National Research Council, Ottawa). Phys. Rev. **118**, 154-7(1960) Apr. 1.

The effective range in the singlet electron-hydrogen system was evaluated as 2.646 ± 0.004 atomic units by using the asymptotic amplitude of the 202-parameter H^- wave function of Pekeris. This value of the effective range, together with the value of the electron affinity of H^- , determines the scattering length in the singlet system as 6.167 atomic units. The effective range in the triplet system is calculated to be 1.219 atomic units by a Hartree-Fock approximation. It is shown that the effective-range approximation is very good for all energies at which only elastic scattering is allowed. The photo-ionization of H^- is briefly discussed on the basis of the effective-range theory. (auth)

15219

UPPER BOUNDS ON SCATTERING LENGTHS WHEN COMPOSITE BOUND STATES EXIST. Leonard Rosenberg, Larry Spruch, and Thomas F. O'Malley (New York Univ., New York). Phys. Rev. **118**, 184-92(1960) Apr. 1.

In the case of the zero-energy scattering of one compound system by another, where one real scattering length completely characterizes the problem (e.g., the reaction $A + B \rightarrow C + D$, in addition to $A + B \rightarrow A + B$, cannot take place) it has previously been shown that the Kohn-Hulthén variational principle provides an upper bound on the scattering length if no composite bound states exist. The extension of this result to the case where one or more composite bound states do exist is presented here. The inclusion of tensor forces, exchange forces, and Coulomb forces is allowed. Several methods are given for obtaining a rigorous upper bound on the scattering length, which involve the addition of certain positive terms to the Kohn-Hulthén variational expression. The approximate information about the composite bound states which is required to construct these additional terms can be found by standard methods. As a consequence of one of the results obtained, it is shown that under certain circumstances some ordinary variational calculations give a bound. Thus, an analysis of a previous calculation in the light of the present results leads, without further calculations, to a rigorous upper bound on the singlet electron-hydrogen scattering length. (auth)

15220

THEORY OF THE PHOTODISINTEGRATION OF THE DEUTERON. L. D. Pearlstein and A. Klein (Univ. of Pennsylvania, Philadelphia). Phys. Rev. **118**, 193-211(1960) Apr. 1.

By means of a covariant field-theoretic technique, a formally exact expression is derived for the amplitude for photodisintegration of the deuteron. By expanding the result only in the number of mesons exchanged and by making a series of nonrelativistic approximations, the expression is reduced to one in which the corrections to the conventional dipole matrix element depend only on the amplitude for photomeson production, the renormalized meson-nucleon coupling constant, and the appropriate two nucleon wave functions. One finds that virtual meson effects play little role at energies below 100 Mev, in justification of recent calculations based on the conventional nonrelativistic theory. At higher energies good agreement with the total

cross section was obtained by the inclusion of both hard core and tensor force effects in the wave functions. In addition the folded angular distribution could be fitted by using a reasonable extrapolation of the phase shifts in the 1S_0 and 1D_2 states. (auth)

15221

SCATTERING OF HIGH-ENERGY NUCLEONS BY A NON-LOCAL POTENTIAL. R. H. Lemmer and Y. C. Tang (Florida State Univ., Tallahassee) and W. E. Frahn (Council for Scientific Industrial Research, Pretoria). *Phys. Rev.* **118**, 269-70(1960) Apr. 1.

The scattering of high-energy nucleons by a simple non-local potential is examined in the Born approximation. It is shown that an energy dependent local potential is not fully equivalent to a nonlocal potential. The latter potential introduces an additional angular dependence in the differential cross section which seems to be particularly significant in the backward directions. (auth)

15222

ACCURATE DETERMINATION OF THE μ^+ MAGNETIC MOMENT. R. L. Garwin, D. P. Hutchinson, S. Penman, and G. Shapiro (Columbia Univ., New York). *Phys. Rev.* **118**, 271-83(1960) Apr. 1.

Using a precession technique, the magnetic moment of the positive mu meson is determined to an accuracy of 0.007%. Muons are brought to rest in a bromoform target situated in a homogeneous magnetic field oriented at right angles to the initial muon spin direction. The precession of the spin about the field direction, together with the asymmetric decay of the muon, produces a periodic time variation in the probability distribution of electrons emitted in a fixed laboratory direction. The period of this variation is compared with that of a reference oscillator by means of phase measurements of the "beat note" between the two. The magnetic field at which the precession and reference frequencies coincide is measured with reference to a proton nuclear magnetic resonance magnetometer. The ratio of the muon precession frequency to that of the proton in the same magnetic field is thus determined to be 3.1834 ± 0.0002 . Using a re-evaluated lower limit to the muon mass, this is shown to yield a lower limit on the muon g factor of $2(1.00122 \pm 0.00008)$, in agreement with the predictions of quantum electrodynamics. (auth)

15223

MUON DECAY IN NUCLEAR EMULSION AT 25,000 GAUSS. G. R. Lynch and J. Orear (Cornell Univ., Ithaca, N. Y.) and S. Rosendorff (Columbia Univ., New York). *Phys. Rev.* **118**, 284-91(1960) Apr. 1.

Positive pions from the 90-Mev pion beam of the Nevis cyclotron were stopped in nuclear emulsion which was in a magnetic field of 25,000 gauss. The asymmetry parameter for the angular distribution of the positrons which came from the decay muons was measured. The result that $P\xi = -0.87 \pm 0.04$ implies that either the asymmetry parameter ξ is different from the value of -1 predicted by the V-A theory or that there is about 13% depolarization of positive muons in nuclear emulsion at 25,000 gauss. (auth)

15224

LOW-ENERGY PION PHENOMENA. J. Hamilton (Christ's Coll., Cambridge, Eng.) and W. S. Woolcock (Clare Coll., Cambridge, Eng.). *Phys. Rev.* **118**, 291-9(1960) Apr. 1.

The relation between low-energy pion-nucleon scattering and pion photoproduction is examined. Correct extrapolation to threshold of both the π^+ and π^- photoproduction data gives agreement with theory. A recent new method for analyzing the scattering data is applied giving $a_1 = 0.178$,

$a_2 = -0.087$, and reasonable agreement with the Panofsky ratio $P = 1.5$ is obtained. An inner Coulomb correction to the scattering data helps to improve this agreement. The possibility of detecting a $\pi-\pi$ interaction by low-energy pion scattering is examined. A new dispersion relation connects the s- and p-wave phase shifts at low energies; this relation excludes some well-known sets of phase-shift curves. (auth)

15225

RESULTS ON THE π^- -PROTON SCATTERING AT 1 BEV AND A COMPARISON WITH THE LINDENBAUM-STERNHEIMER MODEL. I. Derado and N. Schmitz (Max-Planck-Institut für Physik und Astrophysik, Munich). *Phys. Rev.* **118**, 309-15(1960) Apr. 1.

In photographs from the 10-in. hydrogen bubble chamber at Berkeley 640 π^- -proton scattering events with two secondary tracks were analyzed. The primary π^- energy was 1 Bev. The cross sections for the various reactions, especially $\pi^- + p \rightarrow \pi^- + p$, $\pi^- + p \rightarrow \pi^- + n + \pi^+$, and $\pi^- + p \rightarrow \pi^- + p + \pi^0$ were determined. The ratio $\sigma(\pi^- + p + \pi^0)/\sigma(\pi^- + n + \pi^+)$ of the two inelastic reactions turned out to be $0.50^{+0.12}_{-0.14}$. The differential cross section of the π^- for the elastic scattering and the momentum and angular distributions of the secondary particles from the two inelastic processes are given. The momentum spectra exhibit two maxima which strongly indicate the existence of the isobaric nucleon state. However, the results can hardly be explained by the Lindenbaum-Sternheimer model quantitatively, as has been shown in two independent ways. Perhaps this discrepancy is an indication that those pion productions must not be neglected which do not go through the intermediate state of the isobar but through the direct channel. (auth)

15226

RESONANT SCATTERING OF ANTINEUTRINOS.

Sheldon L. Glashow (Inst. for Theoretical Physics, Copenhagen). *Phys. Rev.* **118**, 316-17(1960) Apr. 1.

The hypothesis of an unstable charged boson to mediate muon decay radically affects the cross section for the process $\bar{\nu} + e \rightarrow \bar{\nu} + \mu^-$ near the energy at which the intermediary may be produced. If the boson is assumed to have K-meson mass, the resonance occurs at an incident antineutrino energy of $\sim 2 \times 10^{12}$ ev. The flux of energetic antineutrinos produced in association with cosmic-ray muons will then produce two muon counts per day per square meter of detector, independently of the depth and the orientation at which the experiment is performed. (auth)

15227

MAGNETIC QUENCHING OF HYPERFINE DEPOLARIZATION OF POSITIVE MUONS. R. A. Ferrell, Y. C. Lee, and M. K. Pal (Univ. of Maryland, College Park). *Phys. Rev.* **118**, 317-19(1960) Apr. 1.

The depolarization of positive muons being slowed down in an insulating material can only be accounted for by the capture of an electron into a bound state. The ground-state muonium formed in flight can be expected to break up in a time short compared to 10^{-10} sec (the time necessary for the electron to flip the muon spin via the hyperfine interaction). The effect of an external magnetic field in locking the electron spin in its initial orientation, and thereby quenching the action of the hyperfine coupling, is a useful test of the assumption of muonium as the depolarizing mechanism. If x is the magnetic field strength measured in units of 1.58 kilogauss, and τ is twice the mean life of the muonium atoms with respect to breakup, measured in units of 3.58×10^{-11} sec, then it is found that the amount of de-

polarization for one formation and breakup process is equal to one-half of the quantity $(1 + \tau^{-2} + \kappa^2)^{-1}$. By introducing n , the number of times that the capture-breakup process is repeated, one has two parameters and can achieve good fits to the experimental data of Sens et al., for nuclear emulsion and fused quartz. It is pointed out that the interpretation by Sens et al. of their magnetic quenching data, also based on a two-parameter formula, is not tenable, since it depends on assuming that a certain fraction of the muons are not subject to the capture and loss process. (auth)

15228

HIGHER RESONANCES IN PION-NUCLEON INTERACTIONS. Ronald F. Peierls (Univ. of California, Berkeley). *Phys. Rev.* **118**, 325-35(1960) Apr. 1.

The recent experiments on pion-nucleon scattering and photoproduction at energies up to about 1.2 Bev are examined from a phenomenological standpoint. The most useful information seems to come from the photoproduction angular distribution and polarization results. The data seem to imply the existence of two "resonances" in the $J = \frac{3}{2}$, odd parity and $J = \frac{1}{2}$, even parity states at photon energies of about 750 and 1100 Mev. These assignments satisfy several nontrivial consistency requirements. The same two states are also a consistent assignment for the observed scattering resonances at 615 Mev and 950 Mev. A qualitative model is proposed to explain these resonances as consequences of the 33 resonance acting in two-meson final states; their isotopic spin dependence seems to require some additional assumptions. Finally, the relation between the photoproduction and scattering phases in the presence of strong inelastic scattering is examined. (auth)

15229

DIRAC-LIKE WAVE EQUATIONS FOR PARTICLES OF NONZERO REST MASS, AND THEIR QUANTIZATION. J. S. Lomont (International Business Machines Research Center, Yorktown Heights, N. Y.) and H. E. Moses (New York Univ., New York). *Phys. Rev.* **118**, 337-48(1960) Apr. 1.

The basic algebraic structure of the Dirac equation for the electron is used as a model for wave equations for other particles of nonzero rest mass. Wave equations of the form $(\gamma^\mu \nabla_\mu + m)\psi = 0$, where the γ -matrices satisfy the usual Dirac anticommutation rules $[\gamma_\mu, \gamma_\nu]_+ = 2g_{\mu\nu}$ are then found for every positive integral and half-odd-integral spin. Wave equations of the above form describing multiple spin particles are also found. The improper transformations are given explicitly in their most general form, and quantization is performed. Finally, the vector meson field is treated as an example. (auth)

15230

LIFETIME MATRIX IN COLLISION THEORY. Felix T. Smith (Stanford Research Inst., Menlo Park, Calif.). *Phys. Rev.* **118**, 349-56(1960) Apr. 1.

The duration of a collision is usually a rather ill-defined concept, depending on a more or less arbitrary choice of a collision distance. If the collision lifetime is defined as the limit, as $R \rightarrow \infty$, of the difference between the time the particles spend within a distance R of each other and the time they would have spent there in the absence of the interaction, a well-defined quantity emerges which is finite as long as the interaction vanishes rapidly enough at large R . In quantum mechanics, using steady-state wave functions, the average time of residence in a region is the integrated density divided by the total flux in (or out), and the lifetime is defined as the difference between these residence times with and without interaction. Transformation properties require construction of the lifetime matrix, Q . If the wave

functions ψ_i are normalized to unit total flux in and out through a sphere at $R \rightarrow \infty$, the matrix elements are

$$Q_{ij} = \lim_{R \rightarrow \infty} \left[\int_{R \rightarrow \infty}^{R \rightarrow \infty} \psi_i \psi_j^* d\tau - R(v_i^{-1} \delta_{ij} + \sum_k S_{ik} v_k^{-1} S_{jk}^*) \right]_{A \rightarrow \infty}$$

where the average value is taken to eliminate oscillating terms at large R , S_{ik} is an element of the unitary scattering matrix, S , and v_i is the velocity in the i th channel. Q is Hermitian; a diagonal element Q_{ii} is the average lifetime of a collision beginning in the i th channel. As a function of the energy Q is related to S : $Q = -i\hbar S dS^\dagger/dE$; Q and S contain the same information, from complementary points of view. When Q is diagonalized, its proper values, q_{ii} , are the lifetimes of metastable states if they are large compared to \hbar/E ; for a sharp resonance, the measured lifetime is the average of $q_{ii}(E)$ over a distribution in energy. The corresponding eigenfunctions, Ψ_i , are the proper functions to describe these metastable states. The causality principle appears directly from an inequality involving the integral expression for Q_{ij} or q_{ii} , and it is shown how some of its consequences for inelastic collisions can be deduced. (auth)

15231

PION-PION AND PION-KAON SCATTERING. Susumu Okubo (Univ. of Rochester, N. Y.). *Phys. Rev.* **118**, 357-60(1960) Apr. 1.

An easier derivation of Chew-Mandelstam's effective-range formula for pion-pion scattering is given using the conventional Feynman method with the interaction Hamiltonian $H_1 = 4\pi\lambda\phi^4$ in an approximation where only the chain diagrams are included. A correction term to this formula due to the cross-diagram is calculated both for S waves and P waves. The method is applied to pion-kaon scattering. (auth)

15232

LOW-LYING EXCITATIONS IN A BOSE GAS OF HARD SPHERES. F. Mohling (Columbia Univ., New York) and A. Sirlin (New York Univ., New York). *Phys. Rev.* **118**, 370-8(1960) Apr. 15.

The pseudopotential method is used to calculate that low-lying excitation energies of a Bose gas of hard spheres at $T = 0$ to an order beyond that previously calculated by this technique. The results are in agreement with those obtained by Beliaev using a different approach. The phonon velocity is found to be equal to the velocity of compressional waves to the order of approximation considered. (auth)

15233

PLASMA OSCILLATIONS OF A LARGE NUMBER OF ELECTRON BEAMS. John M. Dawson (Princeton Univ., N. J.). *Phys. Rev.* **118**, 381-9(1960) Apr. 15.

Longitudinal oscillations of a large number of electron beams are investigated. The normal modes for the beams are found. An orthogonality relation between the modes is obtained and is used to solve the initial value problem and the problem of forced oscillations. It is demonstrated that no signal propagates faster than the fastest beam. The problem of passing to the limit of a continuous velocity distribution is considered in detail. It is shown that in the limit the results of Landau, Van Kampen, and others are recovered. The problem of Landau damping is discussed from the point of view of the beams. (auth)

15234

SELF-CONSISTENT FIELD AND MOTION OF ELECTRONS WHICH HAVE A RANGE IN CANONICAL ANGULAR MOMENTUM IN A UNIFORM MAGNETIC FIELD. Lewi

Tanks (Univ. of California, Livermore). Phys. Rev. **118**, 390-8(1960) Apr. 15.

The self-consistent theory of relativistic electrons circulating in a uniform impressed magnetic field, the "Astron problem," has been generalized to the extent that a range of canonical angular momentum among monoenergetic electrons has been treated. For simplicity, the density distribution in phase space has been chosen to be uniform over a finite momentum range. Just as in the single-momentum case, field reversal is found, but new field and spatial density configurations appear. The uniform distribution is found to be consistent with isotropic regions of constant spatial density and constant magnetic field. The thickness of transition layer between vacuum and such a region conforms, within limits, to an empirical relation previously found. The limit to the number of electrons per unit axial length of layer still exists. The curves relating the ratio of internal to external field to the layer strength still show multiple values of both ratio and strength in certain ranges. Trajectories have been calculated and plotted for several cases. (auth)

15235

INTERACTION OF K^+ MESONS WITH PROTONS. T. F. Kycia, L. T. Kerth, and R. G. Baender (Univ. of California, Berkeley). Phys. Rev. **118**, 553-61(1960) Apr. 15.

The total K^+-p cross section was measured at the three K^+ -meson energies 175 ± 25 , 225 ± 25 , and 275 ± 25 Mev, and the differential scattering cross section was measured at 225 Mev. The K^+-p nuclear force was shown to be repulsive, from the observed constructive interference with Coulomb scattering. The differential cross section was otherwise isotropic and could arise from either pure S-wave or pure P-wave scattering. Subtracted dispersion relations were applied to these data and the rest of the available K-proton scattering data. The statistical errors in the data were found to be too large to determine the K-hyperon relative parity. On the assumption that the KA and KE relative parities are the same, then for scalar coupling, $g^2/4\pi$ would be less than 0.6; for pseudoscalar coupling, it would be less than 10. (auth)

15236

HIGH-ENERGY K^- -MESON INTERACTIONS AND DECAYS. Stanley C. Freden, Francis C. Gilbert, and R. Stephen White (Univ. of California, Livermore). Phys. Rev. **118**, 564-76(1960) Apr. 15.

The interactions of 20 to 300 Mev K^- mesons on free protons and on emulsion nuclei were studied and their decays analyzed. The K^- -meson mean lifetime is found to be $(1.38 \pm 0.24) \times 10^{-8}$ sec. Examples of the decay modes $K_{\mu 2}$, $K_{\pi 2}$, $K_{\mu 3}$, τ , and τ' are identified. The branching ratios are found to be in agreement with those for K^+ mesons. The (K^-p, K^-p) elastic scattering cross section is found to be 35 ± 16 mb and the $(K^-p, \Sigma^+\pi^-)$ cross section 27 ± 13 mb in the energy region of 150 to 300 Mev. The mean free path for K^- -meson captures and inelastic scatters on emulsion nuclei, except hydrogen, can be represented by $\Lambda(\text{cm}) = (17.2 \pm 3.4) + (0.081 \pm 0.027) T_K$, where T_K is the laboratory K^- -meson kinetic energy, for K^- -meson energies from 20 to 300 Mev. This increase in the mean free path with K^- -meson energy is explained in terms of the decreasing nucleon cross section. The fraction of the interactions of K^- mesons on nuclei which are inelastic scatters increases from 2% at low K^- -meson energies to about 15% at 150 Mev. This increase in inelastic scattering with energy is additional evidence that the nucleus is becoming partially transparent to K^- mesons at about 150 Mev. Data are presented for the

fraction of events with observed π mesons, Σ hyperons, and π meson- Σ hyperon pairs. The data are discussed in terms of the model which was previously presented to explain K^- meson captures at rest on nucleons bound in nuclei. (auth)

15237

π^+-p INTERACTIONS PRODUCING Σ^+-K^+ IN A PROPANE BUBBLE CHAMBER. W. H. Hannum, H. Courant, E. C. Fowler, H. L. Kraybill, J. Sandweiss, and J. Sanford (Yale Univ., New Haven). Phys. Rev. **118**, 577-9(1960) Apr. 15.

Seven cases of production of Σ^+-K^+ by 1.0-Bev π^+-p interactions were identified in the Yale propane bubble chamber. In six of these cases, the Σ^+ direction was forward in the center-of-momentum system. The cross section derived from these is 0.08 mb. The decay of the Σ^+ is equally divided between the pion and proton decay modes. (auth)

15238

FURTHER SEARCH FOR THE DECAY $\mu^+ \rightarrow e^+ + \gamma$. S. Frankel, V. Hagopian, J. Halpern, and A. L. Whetstone (Univ. of Pennsylvania, Philadelphia). Phys. Rev. **118**, 589-90(1960) Apr. 15.

A new experiment for determining the upper limit for the branching ratio R of the process $\mu^+ \rightarrow e^+ + \gamma$ relative to the normal decay mode $\mu^+ \rightarrow e^+ + \nu + \bar{\nu}$ yields a value of R of less than 1.2×10^{-6} with a 90% confidence level. (auth)

15239

RELATIVISTIC PION-HYPERON DISPERSION RELATIONS. Richard H. Capps and Michael Nauenberg (Cornell Univ., Ithaca, N. Y.). Phys. Rev. **118**, 593-602(1960) Apr. 15.

Relativistic, fixed momentum-transfer dispersion relations are derived (but not proved) for pion scattering from Σ and Λ particles and the processes $\pi + \Lambda \approx \pi + \Sigma$. Separate equations for the S- and P-wave amplitudes are obtained under the assumptions that high-energy processes and baryon recoil may be neglected. The P-wave equations are identical to those derived from Chew-Low theory for these processes. A brief discussion is given of the behavior of the P-wave amplitudes under the assumption of global symmetry. It is pointed out that the production of K-N pairs may play an important role in both the S- and P-wave equations. (auth)

15240

RADIATIVE PION DECAY INTO ELECTRONS. Sidney A. Bludman and James A. Young (Univ. of California, Berkeley). Phys. Rev. **118**, 602-5(1960) Apr. 15.

The possibility of distinguishing the pion structure-dependent radiation from the conventional inner bremsstrahlung radiation in the radiative decay of pions into electrons is discussed. Calculation of the photon energy spectrum and angular correlation shows that evidence for pion structure would be obtained if any photons of energy less than 70 Mev were detected in 180° coincidence with π -decay electrons. The probability of such events per unit solid angle is $\geq 0.2 \times 10^{-7}$ relative to ordinary $\pi \rightarrow \mu + \nu$ decay, if the assumption of a conserved vector current is made to relate the rate of radiative decay through the weak V-interaction to the rate of $\pi^0 \rightarrow 2\gamma$ decay. (auth)

15241

THEORY OF ALLOWED AND FORBIDDEN TRANSITIONS IN MUON CAPTURE REACTIONS. Masato Morita (Columbia Univ., New York) and Akihiko Fujii (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. **118**, 606-17(1960) Apr. 15.

A general formula for the transition rate of the muon capture reaction, $\mu^- + (A, Z) \rightarrow \nu + (A, Z-1)$, where the final nuclear state has definite spin and parity, is given in terms of the total and orbital angular momenta of the emitted neutrino and of the spins of the initial and final nuclear states. The induced pseudoscalar interaction and the interaction due to the assumption of conserved vector current are taken into account, together with the vector and axial vector interactions. The forbiddenness of the muon capture reaction is defined in a manner analogous to the theory of the beta decay. The spin and parity changes can assume the values $(0+, 1+)$, $(0-, 1-, 2-)$, $[n(-)^n, n+1(-)^n]$ for the allowed, first forbidden, and n th ($n \geq 2$) forbidden transitions, respectively. (+ and - mean the parity change "no" and "yes.") For these transitions, the number of reduced nuclear matrix elements involved is nine, sixteen, and fourteen, respectively. The transition rate of muon capture reaction is reduced by a factor of 10^3 , approximately, for a two-unit increase of the forbiddenness, if the atomic number and the energy of neutrino are constant. The contribution from the higher order transition to the lower one is less than 0.1% in the medium and light nuclei. Explicit formulas for the transition rate are given for the allowed, first forbidden and n th forbidden transitions. They are related to the corresponding formulas of beta decay. Our formalism was applied to the calculation of the partial muon capture rate by ^{12}C ending in the ground state of ^{12}B . The numerical analysis indicates that measurement of this capture rate can determine whether the conserved vector current interaction term exists in nature only if the coupling constant of the induced pseudoscalar interaction and the nuclear wave functions are well known. The transition rates are given in Table V and Fig. 1 for the j - j coupling shell model and harmonic oscillator wave functions. They are 9-13% smaller than those given by Fujii and Primakoff. (auth)

15242

APPLICATION OF DISPERSION RELATIONS TO K_{e3} AND $K_{\mu 3}$ DECAYS. R. F. Sawyer (Univ. of Wisconsin, Madison). *Phys. Rev.* **118**, 618-22(1960) Apr. 15.

The decay modes, K_{e3} and $K_{\mu 3}$, are studied by means of a dispersion relation. It is assumed that the fundamental couplings involved are the strong pion and K-meson couplings to the baryons and a weak four-field coupling connecting nucleon, hyperon, and the lepton pair. The baryon-antibaryon pair contribution to the absorptive part of the decay amplitude is expressed in terms of the imaginary part of the pion propagator in the same approximation. The decay rate is determined in terms of the various coupling constants and the quantity Z which renormalizes the pion propagator. Comparison with experiment is made for the case $g_\pi^2/g_K^2 = 15$. The results are consistent with a hyperon leptonic decay coupling constant an order of magnitude less than the beta-decay strength. (auth)

15243

PANOFSKY RATIO. N. P. Samios (Columbia Univ., New York). *Phys. Rev. Letters* **4**, 470-2(1960) May 1.

The Panofsky ratio P , defined as the relative probability of mesonic to radiative capture of π^- mesons from the K shell in hydrogen, has been measured many times. The results of these measurements, 0.94 ± 0.30 to 1.87 ± 0.10 , are tabulated. The method used to obtain P is explained. The value obtained from this experiment was 1.62 ± 0.06 . (B.O.G.)

15244

CONSTRUCTION OF COUPLED SCATTERING AND PRO-

DUCTION AMPLITUDES SATISFYING ANALYTICITY AND UNITARITY. J. D. Bjorken (Stanford Univ., Calif.). *Phys. Rev. Letters* **4**, 473-4(1960) May 1.

The methods for constructing single-channel scattering amplitudes, production amplitudes, and vertex functions on the basis of analyticity and unitarity have been extended to the case of n^2 coupled amplitudes $T_{ij}(\omega)$ representing the production and scattering among n different channels, each of which may have a different threshold energy. The equations for these methods are derived and applications to double pion production, associated production, and K^-N scattering are in progress. (B.O.G.)

15245

EFFECT OF PION-PION RESONANCES ON $\pi^- p$ INTERACTIONS. L. Landovitz and L. Marshall (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev. Letters* **4**, 474-5 (1960) May 1.

The production of π mesons by π mesons has been reported for energies of 960 Mev and 1 Bev. In one, the π^- from the process $\pi^- + p \rightarrow \pi^- + p + \pi^0$ emerges predominantly fast, whereas it is predominantly slow in the other. A possible explanation is given for a model which leaves the interpretation of the first pion spectrum unaltered but which could fit the second spectrum owing to the rapid onset of another process. The ratio of fast to slow π^- production is given as limits for T states of 0, 1, and 2. The ratio of the $\pi + \pi^-$ reactions to the $\pi^- + \pi^0$ reactions is given for the case $T = 1$. (B.O.G.)

15246

THE NUCLEON-NUCLEON SPIN-ORBIT POTENTIAL. Gregory Breit (Yale Univ., New Haven). *Proc. Natl. Acad. Sci. U.S.A.* **46**, 746-53(1960) May.

Empirical evidence for considering the repulsive core of nucleon-nucleon interactions and the spin-orbit interaction as originating in a vector field coupling is discussed. It is shown that the large mass of the mesons which appears to fit present scattering experiments should have been an obstacle in their direct detection. Antinucleon-nucleon scattering falls in naturally with the explanation. Related phenomena such as the photodisintegration of the deuteron, the binding energy of the triton, and electromagnetic nucleon form factors are found not to contain direct contradictions with the hypothesis and even to support it to a degree. (auth)

15247

MEASUREMENT OF THE POLARIZATION OF DEUTERONS IN THE REACTION $p + p \rightarrow d + \pi^+$ AT PROTON ENERGIES OF 670 Mev. Yu. K. Akimov, K. S. Marish, O. V. Savchenko, and L. M. Soroko (Joint Inst. for Nuclear Research, Dubna, USSR). *Rev. phys.* **4**, 359-71(1959). (In Russian)

Vector polarization of deuterons from the reaction $p + p \rightarrow d + \pi^+$ was measured at proton energies of 670 Mev at angles of 121° , $140^\circ 30'$, and 162° in the center-of-mass system. The amplitude of the non-resonance $^1S_0 \rightarrow ^3S_1 p_0$ transition was found. The contribution of this transition to the total cross section was about 1%. The measured angular dependence of the vectorial polarization of deuterons does not contradict the hypothesis that the amplitude of the transitions from the 3F_2 and 3F_3 ground states of two protons is zero. (tr-auth)

15248

THE BRANCHING RATIO OF THE DECAY OF THE K^+ -MESON. W. T. Lee, D. C. Sen, T. H. Ho, and H. Y. Tzu (Inst. of Atomic Energy Research, Academia Sinica, Peking). *Sci. Sinica (Peking)* **8**, 48-60(1959) Jan. (In English)

The branching ratios of three modes of K^+ -meson decay; $K^+ \rightarrow \mu^+ + \pi^0 + \nu$, $K^+ \rightarrow e^+ + \pi^0 + \nu$, and $K^+ \rightarrow \mu^+ + \nu$, are calculated by using the Fermi weak interaction theory. The perturbation method with cut-off is used. The ratio obtained is 1:1.5:12, which is in fair agreement with the experimental value 1:1:15. It is shown that other combinations of the Fermi interactions can not give results in agreement with experiment. (auth)

15249

WAVE FUNCTIONS AND POLARIZATION STATES OF A TWO-PHOTON SYSTEM. Y. Wang (Academia Sinica, Peking). *Sci. Sinica (Peking)* **8**, 172-82(1959) Feb. (In English)

Previous studies of two-photon systems devoted to the relations of the number of states, polarizations, parity, and angular momentum are reviewed. It was deduced that these presentations were not in agreement and were unsatisfactory. Wave functions are calculated for the two-photon system and compared with the determinations found in the previous studies. (B.O.G.)

15250

ANGULAR DISTRIBUTION OF THE DECAY PRODUCTS OF THE HYPERON. J. M. Chen, T. H. Ho, D. C. Sen, and H. Y. Tzu (Inst. of Atomic Energy Research, Academia Sinica, Peking). *Sci. Sinica (Peking)* **8**, 233-48(1959) Mar. (In English)

Assuming various forms of interaction Hamiltonian, the angular distribution of the decay products of a spin $\frac{1}{2}$ particle obeying the Dirac equation and that of a spin $\frac{3}{2}$ particle obeying the Rarita-Schwinger equation is calculated. The ratio of the strength of parity conserving and parity non-conserving interactions and the asymmetry parameter α is discussed. It is pointed out that if the vector and pseudo-vector coupling in the universal Fermi interaction are exactly equal to each other, then this theory gives an asymmetry parameter α of the Λ particle decay which is consistent with experimental results. If the ratio of the square of these coupling constants is no longer equal to one, due to the renormalization effect, then the asymmetry parameter might be considerably modified. The accurate determination of α will be useful to the investigation of the renormalization effect of the Feynman-Gell-Mann universal Fermi weak interaction. The angular distribution of the decay products of spin $\frac{3}{2}$ particle obeying the Rarita-Schwinger wave equation cannot be made to agree with the experimental result of the Λ particle decay, a conclusion which was first pointed out by Lee and Yang by using general arguments. (auth)

15251

ON THE BRANCHING RATIOS OF THE DECAYS OF THE HYPERONS AND THE RATIOS OF THE MEAN LIFE TIMES. J. M. Chen, T. H. Ho, D. C. Sen, and H. Y. Tzu (Inst. of Atomic Energy Research, Academia Sinica, Peking). *Sci. Sinica (Peking)* **8**, 249-65(1959) Mar. (In English)

The branching ratios for hyperon decay, the ratios of mean life times of the decaying hyperons, and the ratios of the life time of hyperons to that of the K-meson are calculated using the universal Fermi weak interaction of Feynman and Gell-Mann and the strong interaction of Salam. The perturbation theory is used with a cut-off in the region of large momentum. By using the coupling constants of the strong interaction given by Warner and choosing suitable values for the remaining coupling constants, most of these calculations agree fairly well with

experiments. The worst result differs from experimental values at most by a factor of 2. The theoretical values of the branching ratios of K^+ -decay are derived from this set of new coupling constants, showing better agreement with the experiment than the results obtained previously. These calculations show that the universal Fermi weak interaction of the V-A type gives quite a satisfactory explanation of the decay phenomena of K-mesons and hyperons. It is evident from the calculations that the decays must be regarded as phenomena brought about by the joint action of strong and weak interactions, and that there exist two classes of strong interactions: the "very strong" and the "medium strong." The results favor the assumption that the Λ and Σ particles have the same parity. It shows that of the 4 terms of the strong interaction Hamiltonian given by Salam involving the K-meson, at least two terms involve the γ_5 matrix. (auth)

15252

ON THE ANGULAR DISTRIBUTION OF THE DECAY PRODUCTS OF PARTICLES OF ARBITRARY SPIN. J. M. Chen, T. H. Ho, D. C. Sen, and H. Y. Tzu (Inst. of Atomic Energy Research, Academia Sinica, Peking). *Sci. Sinica (Peking)* **8**, 416-22(1959) Apr. (In English)

The angular distribution of the decay products of particles of arbitrary spin decaying into a particle of spin zero and a particle of spin $\frac{1}{2}$ is investigated. The expressions for the expansion coefficients are derived. It is found that the coefficients of terms of even order spherical harmonics are independent of the detailed form of the interaction Hamiltonian inducing the decay process. But the expansion coefficients of terms of odd order spherical harmonics depend on a parameter α , which is a measure of the interference between the parity conserving and nonconserving interactions. The maximum values which can be taken by the various coefficients are given. It is found that the maximum values of the even coefficients increase with the value of the spin of the initial particle, while those of the odd coefficients decrease correspondingly. The expression for the density matrix of the initial particle as a function of these expansion coefficients is given, and can be used to determine the state of polarization of the initial particle and the interference between the parity conserving and parity nonconserving interactions, when the expansion coefficients are known. (auth)

15253

THE RADIATIVE CAPTURE OF μ^- -MESON BY PROTON. Y. B. Dye, D. C. Sen, T. H. Ho, and H. Y. Tzu (Inst. of Mathematics and Inst. of Atomic Energy Research, Academia Sinica, Peking). *Sci. Sinica (Peking)* **8**, 423-8(1959) Apr. (In English)

The radiative capture of μ^- -mesons by protons is treated by the renormalized universal Fermi interaction of the V-A type and Zel'dowich's theory on μ -meson hydrogen. Contrary to the result of Lee, Huang, and Yang, it is found that if the effect of the strong interaction is neglected, it is impossible for photons to be emitted during the capture. The influence of the strong interaction consists of the effect of the magnetic moment of the nucleon and the renormalization effect on the universal Fermi weak interaction. The effect of the anomalous magnetic moment is negligible. The contribution of protons to the emission of photons is not small in comparison with that of the μ -meson, due to the renormalization effect on the universal Fermi weak interaction. The photons emitted are no longer 100% right hand polarized. It is estimated that only 82% of the photons have spins parallel to momentum. The

radiative capture rate of μ^- -mesons by protons is 6.6×10^{-4} of the total capture rate. (auth)

15254

PRODUCTION AND DECAY OF THE STRANGE PARTICLES. An-shiang Ho (Inst. of Atomic Energy). Sci. Sinica (Peking) **8**, 468-84(1959) May. (In English)

The cloud chamber used has a volume of 9000 cm³, a magnetic field of 6200 gauss, and is operated at an altitude of 3185 m. In a set of 30,000 pairs of photographs, 105 decay events of neutral V particles and 21 of charged particle decay were observed. It is seen that 16 events were decays of Λ^0 particles, 26 were θ_1^0 particles, one was a θ_2^0 particle, and 62 were nonclassified. The following properties of the Λ^0 and θ^0 particles were studied: Q values; $Q_{\Lambda^0} = (36.2 \pm 2.5)$ Mev, $Q_{\theta_1^0} = (233 \pm 11)$ Mev. Mean lifetimes; $\tau_{\Lambda^0} = (3.19^{+2.42}_{-0.92}) \times 10^{-10}$ sec, $\tau_{\theta_1^0} = (1.14^{+0.49}_{-0.27}) \times 10^{-10}$ sec. The momentum distributions found for the Λ^0 and θ_1^0 particles have no significant difference from earlier results. $N(\Lambda^0)/N(\theta_1^0) = 0.51 \pm 0.22$ (corrected number in lead). The angular distributions of the decay products of Λ^0 and θ_1^0 particles in the rest system have no marked asymmetry. The lifetime of one θ_2^0 particle is estimated to be 10^{-8} sec in the rest system. The decay mode of this particle is probably $\theta_2^0 \rightarrow \pi^- + \pi^+ + \pi^0$ or $\theta_2^0 \rightarrow \pi^+ + \mu^- + \nu$. (auth)

15255

A STUDY OF Λ^0 AND θ^0 PARTICLES PRODUCED IN Pb AND Al. Min Li, Jen-chi Cheng, and Ho-nian Li (Inst. of Atomic Energy). Sci. Sinica (Peking) **8**, 485-509(1959) May. (In English)

Two experiments on the V^0 particles were carried out with a multiplate cloud chamber during 1955 to 1957. A total of 550 V^0 particles were found. The 67 Λ^0 and 44 θ^0 particles are classified by using the α - ϵ method. Among them 58 Λ^0 and 38 θ^0 were produced in Pb; 9 Λ^0 and 6 θ^0 were produced in Al. The following results were obtained: (1) The decay angle in the center of mass system of Λ^0 or θ^0 is uniformly distributed. The correlation angle between the production plane and the decay plane is also distributed uniformly. No information can be obtained to the effect that the spins of the V^0 particles are larger than $1/2$. (2) No asymmetry of angular distribution showing nonconservation of parity is seen for the decays of the Λ^0 particles produced in Pb. For Λ^0 produced in Al some indications of asymmetry are noted. (3) The hyperon tends to go backward in the associated production process from the consideration of the momentum spectrum and production angle distribution. (4) The following lifetimes are obtained: $\tau_{\Lambda^0} = (3.39^{+0.63}_{-0.44}) \times 10^{-10}$ sec; $\tau_{\theta^0} = (0.86^{+0.24}_{-0.16}) \times 10^{-10}$ sec. (5) $N(\Lambda^0)/N(\theta^0) \sim 1.4$. (6) The total cross section for strange particle production is estimated to be of the order of 0.8 mb/nucleon, for both Pb and Al. (7) The Pb nucleus is more effective than the Al nucleus for producing a V^0 particle, when the percentage of the V^0 is considered with respect to the total number of secondary particles. (auth)

15256

THE EFFECT OF THE STRUCTURE OF THE NUCLEON ON THE CAPTURE OF μ^- MESON BY PROTON. Y. B. Dai, T. H. Ho, and H. Y. Tzu (Inst. of Mathematics and Inst. of Atomic Energy Research, Academia Sinica, Peking). Sci. Sinica (Peking) **8**, 802-6(1959) Aug. (In English)

It is pointed out that, owing to the similarity existing between the electromagnetic interaction and the vector part of the weak interaction proposed by Feynman and Gell-Mann, the contribution of the vector part of the weak interaction to μ^- capture by proton is closely related to the electromagnetic form factors of the nucleon. Formulas

for the capture probability calculated with the renormalized V-A weak interaction are given. The correction to the contribution of the vector part of the weak interaction due to the charge and magnetic moment distribution of the nucleon is estimated for data of electron-nucleon scattering experiments. (auth)

15257

THE INFLUENCE OF STRONG INTERACTION ON DECAY PROCESSES. N. Hu, N. N. Huang, and P. Wang (Joint Inst. for Nuclear Research). Sci. Sinica (Peking) **8**, 1343-52(1959) Nov. (In English)

It is shown that the strong interaction introduces phase shifts representing final-state interaction and new parameters into the transition matrix for hyperon decay processes. These parameters must be determined by solving problems of physical hyperons under strong interaction with the π -meson and K-meson fields. As a consequence the selection rule read off from the Hamiltonian is in general different from that given by the transition matrix. The general consideration is applied to the case of universal Fermi interactions including hyperons. Consistency with the selection rule $\Delta T = \pm 1/2$ cannot be achieved unless the interaction includes the charge-retention pairs such as (N^+, N^+) , (N^0, N^0) , and (N^0, Λ^0) . The theoretical difficulties of including these pairs are discussed. (auth)

15258

ELECTRON BEAM FOCUSING WITH PERIODIC MAGNET STRUCTURES. Kuo-chu Ho (Nankai Univ., Tientsin, Hopeh, China). Sci. Sinica (Peking) **8**, 1471-89(1959) Dec. (In English)

The electron beam profile and the focusing conditions were studied for sinusoidal and non-sinusoidal periodic magnetic fields. The change of the location of the first stop band with various values of cathode shielding coefficients is shown graphically. A varying amplitude and phase method was applied to investigate the stability of the beam. (B.O.G.)

15259

FORMULAS FOR TWO-ELECTRON MATRIX ELEMENTS OF SPIN INTERACTION OPERATORS. A. P. Yutis (Yucys) and R. S. Dagis (Dagys) (Inst. of Physics and Mathematics, Lithuanian SSR). Trudy Akad. Nauk Litovskoi S.S.R., Ser. B, No. 1, 41-57(1960). (In Russian)

A systematic method for expressing matrix elements of spin interactions by radial integrals is offered. Formulas for diagonal matrix elements related to two-electron configurations fs, fp, fd, and f² and for corresponding expressions of matrix elements binding the configurations p², d², and f² are derived. (tr-auth)

15260

SPECTRA OF INTERACTING PARTICLE SYSTEMS AND COLLECTIVE LOSSES IN CHARGED PARTICLE PASSAGE THROUGH SUBSTANCES. Yu. L. Klimontovich and V. P. Silin. Uspekhi Fiz. Nauk **70**, 247-86(1960) Feb. (In Russian)

Collective excitation spectra in systems of interacting particles and energy losses in the excitation (within Bose statistics) of collective oscillations during the passage of particles through substances are discussed. Kinetic equations for the distribution quantum function, the collective oscillation spectra in self-consistent field approximation, the influence of particle correlation on collective oscillation and excitation spectra, and the phenomenological theory of degenerate electron Fermi liquid are analyzed. Energy losses related to the excitation of collective oscillations in the medium and the non-linear effects in

charged particle passage through plasma are also considered. 109 references. (R.V.J.)

15261

ON THE MULTIPLE PARTICLE PRODUCTION IN HIGH-ENERGY INTERACTIONS. E. L. Feinberg. Uspekhi Fiz. Nauk **70**, 333-50(1960) Feb. (In Russian)

A review is presented of some basic problems in multiple particle production in high-energy interactions. The principle hydrodynamic theory of frontal collisions and peripheral collisions and correlations of theory and experiments are discussed. (R.V.J.)

15262

INVESTIGATION OF DIRECT PAIR FORMATION BY ELECTRONS. L. Criegee (Technische Hochschule, Karlsruhe, Ger. and Max-Planck-Institut für Chemie, Mainz). Z. Physik **158**, 433-43(1960) Apr. (In German)

The direct production of electron-positron pairs by 31.5-Mev electrons was investigated using a counting device. The external electron beam of a betatron, collimated and by deflection cleaned of photons, passed through a thin copper foil and was collected in a Faraday cup. The fast positrons emerging from the foil were analyzed in a magnetic field and detected by a plastic scintillator. By varying the thickness of the foil the differential cross section for (real) trident production was obtained. It was found to amount to about one third of the cross section predicted by Bhabha's theory (with $k = k' = 1$). (auth)

15263

ELASTIC SCATTERING OF 128 AND 162 Mev π^- -MESONS BY PROTONS. Yu. A. Budagov, S. Viktor, V. P. Dzhelepov, P. F. Ermolov, and V. I. Moskalev. Zhur. Eksptl'. i Teoret. Fiz. **38**, 734-46(1960) Mar. (In Russian)

A hydrogen-filled diffusion cloud chamber in a magnetic field was used to measure the angular distribution of 128 and 162 Mev π^- -mesons elastically scattered on protons. The total elastic scattering cross sections for these energies are respectively $(12.8 \pm 1.0) \times 10^{-27} \text{ cm}^2$ and $(21.4 \pm 1.2) \cdot 10^{-27} \text{ cm}^2$. The angular distribution has the form $a + b \cos \theta + c \cos^2 \theta$ with the coefficients given. At the indicated energies the real parts of the forward scattering amplitudes in $\hbar/m_\pi c$ units are respectively 0.261 ± 0.031 and 0.216 ± 0.033 . These values agree with those computed from the dispersion relations with coupling constant $f^2 = 0.08$. (auth)

15264

THE $pn \rightarrow pn\pi^0$ REACTION IN THE ENERGY RANGE FROM THE THRESHOLD UP TO 665 Mev. A. F. Dunaytsev and Yu. D. Prokoshkin. Zhur. Eksptl'. i Teoret. Fiz. **38**, 747-57(1960) Mar. (In Russian)

By a simultaneous investigation of π^0 -meson production in pd - and pp -collisions, information was obtained on the magnitudes of the total cross sections and angular distributions for the reaction $pn \rightarrow pn\pi^0$ in the energy region from the threshold up to 665 Mev. Comparison of these cross sections with those of other reactions shows that the condition imposed on the relation between the total cross sections of meson production by the isotopic invariance hypothesis is fulfilled (to within 10%) in the energy region investigated. Production of π -mesons in an isotopic spin state $T = 1$ was about twice as intense as that in states with $T = 0$. The angular distribution of π^0 -mesons produced in nucleon-nucleon collisions at an energy of about 650 Mev was found to be approximately isotropic, in contrast to that of the charged pions which is essentially anisotropic. This difference contradicts the hypothesis of the isotopic invariance. (auth)

15265

ON PROCESSES INVOLVING TRANSFER OF MOMENTUM TO THE MEDIUM. M. I. Ryazanov. Zhur. Eksptl'. i Teoret. Fiz. **38**, 854-62(1960) Mar. (In Russian)

The change in the transition probability due to Coulomb scattering of charged particles on atoms of a medium is found for a certain class of processes in which a single charged particle and an arbitrary number of neutral particles in the initial and final states participate. (auth)

15266

QUANTUM ANALOG OF THE COLLISION INTEGRAL FOR ELECTRONS IN MAGNETIC AND ELECTRIC FIELDS. A. M. Kosevich and V. V. Andreev. Zhur. Eksptl'. i Teoret. Fiz. **38**, 882-8(1960) Mar.

The influence of an electric field on the quantum analog of the collision integral for electrons in a magnetic field is investigated. For this purpose the quantum kinetic equation for electrons in a metal in crossed magnetic and electric fields is derived for low temperatures when electron scattering mainly occurs on impurities. It is found that the purely quantum term in the collision integral which is proportional to the electric field and was not taken into account in the kinetic equation by Lifshitz plays an important role in the quantum effects appearing in strong magnetic fields. Oscillations of the transverse electrical conductivity tensor elements which arise with variation of the magnetic field are considered. (auth)

15267

INVESTIGATION OF THE LIMITS OF APPLICABILITY OF THE IONIZATION LOSSES THEORY. M. L. Ter-Mikaelyan. Zhur. Eksptl'. i Teoret. Fiz. **38**, 895-905(1960) Mar. (In Russian)

The energy losses of an arbitrarily moving particle are computed with the aid of Maxwell's macroscopic equations. Separation into ionization losses and radiative losses is carried out without use of perturbation theory. The effect of multiple Coulomb scattering and finiteness of the trajectory length on the ionization losses formulas are considered. It is found that because of the density effect the influence of multiple Coulomb scattering on this part of the losses can be neglected. (auth)

15268

ON THE SIGNIFICANCE OF STRANGE PARTICLES IN FERMI'S STATISTICAL THEORY. V. I. Rus'kin and P. A. Usik. Zhur. Eksptl'. i Teoret. Fiz. **38**, 929-33(1960) Mar. (In Russian)

It is shown that consideration of resonance interaction of two π -mesons in Fermi's statistical theory permits one to explain a number of experimental facts which remained inexplicable by the statistical theory which takes into account only the nucleon isobar ($\frac{3}{2}$, $\frac{3}{2}$). Such facts are the mean multiplicity of π^- and K^- -mesons in $p\bar{p}$ -annihilation, mean multiplicity of strange particles in meson-nucleon collisions, and angular correlations between π -mesons in π^-p -interactions at an energy of 1.0 Bev. (auth)

15269

CHERENKOV RADIATION OF A PARTICLE POSSESSING A CHARGE AND AN INTRINSIC MAGNETIC MOMENT. Mêng-ha Li. Zhur. Eksptl'. i Teoret. Fiz. **38**, 934-6(1960) Mar. (In Russian)

The effect of the spin on the radiation intensity and polarization of a particle possessing a charge and intrinsic magnetic moment in a ferroelectric is studied by quantum electrodynamics methods. An analysis of the radiation near the threshold is presented. (auth)

15270

ON THE ENERGY LEVELS OF μ -MESIC ATOMS. N. I. Zhirnov. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 959-62(1960) Mar. (In Russian)

An approximate method is proposed for calculation of μ -mesic atom energy levels from radial Dirac equations with a potential which simultaneously accounts for nuclear volume and screening effects. (auth)

15271

ELECTRON PHYSICS. THE PHYSICS OF THE FREE ELECTRON. O. Klemperer. New York, Academic Press Inc., 1959. 255p.

The fundamental properties of the free electron are discussed with emphasis on electron dynamics and optics. The book originated from lectures by the author and is intended to serve as a text for undergraduate students. The material is arranged in categories covering cathode ray production, electron motion, electron optics, space charge and flow, cathode ray detection, electron charge, charge-mass ratio, mass and relativistic charge, electron wave nature, and spin and magnetic moment. (B.O.G.)

Nuclear Properties and Reactions

15272 AE-11

Aktiebolaget Atomenergi, Stockholm.
CROSS SECTIONS AND NEUTRON YIELDS FOR U^{233} , U^{235} AND Pu^{239} AT 2200 m/sec. N. G. Sjöstrand and J. S. Story. Apr. 1960. 36p.

The experimental information on the 2200 m/sec values for σ_{abs} , σ_f , α , $\bar{\nu}$, and η for U^{233} , U^{235} , and Pu^{239} was collected and discussed. The values will be used later in an evaluation of a best set of data. In an appendix the isotopic abundances of the uranium isotopes are discussed and also the alpha activities of the uranium isotopes and Pu^{239} . (auth)

15273 AFOSR-TN-60-294

California Inst. of Tech., Pasadena; Collège de France, Paris; and Paris. Université, Orsay. Ecole Normale Supérieure. Faculté des Sciences.

THE AXIAL VECTOR CURRENT IN BETA DECAY. Technical Note No. 17. R. P. Feynman, M. Gell-Mann, and M. Lévy. [1960]. 30p. Contract AF61(052)-173.

In order to derive in a convincing manner the formula of Goldberger and Treiman for the rate of charged pion decay, the possibility that the divergence of the axial vector current in β decay may be proportional to the pion field is considered. Three models of the pion-nucleon interaction (and the weak current) are presented that have the required property. The first, using gradient coupling, has the advantage that it is easily generalized to strange particles, but the disadvantages of being unrenormalizable and of bringing in the vector and axial vector currents in an unsymmetrical way. The second model, using a strong interaction proposed by Schwinger and a weak current proposed by Polkinghorne, is renormalizable and symmetrical between V and A, but it involves postulating a new particle and is hard to extend to strange particles. The third model resembles the second one except that it is not necessary to introduce a new particle. (Renormalizability in the usual sense is then lost, however). Further research along these lines is suggested, including consideration of the possibility that the pion decay rate may be plausibly obtained under less stringent conditions. (auth)

15274 BNL-325(2nd Ed.)(Suppl.1)

[Nuclear Cross Sections Advisory Group, AEC].
NEUTRON CROSS SECTIONS. Second Edition, Supplement

No. 1. D. J. Hughes, B. A. Magurno, and M. K. Brussel [Brookhaven Neutron Cross Section Compilation Group]. Jan. 1, 1960. 132p. (GPO)

A compilation of data on neutron cross sections and resonance parameters, published between July 1958 and November 1, 1959, is presented. (C.J.G.)

15275 NYO-8016

Princeton Univ., N. J. Palmer Physical Lab.
MEASUREMENT OF THE SPIN OF ARSENIC⁷⁶ BY THE ATOMIC BEAM METHOD. Robert L. Christensen. Aug. 1957. 206p. Contract AT(30-1)-937. OTS.

The Princeton focusing atomic beam machine was used to investigate the hyperfine structure in the energy levels of As^{76} . The beam was formed by dissociating molecular arsenic vapor in a magnetron-powered microwave discharge. A six-pole permanent focusing magnet was used in a form of Stern-Gerlach experiment to determine that the discharge was producing about 25% dissociation. A method of taking data was devised which averaged the beam fluctuations over a number of points. Due to the geometry of the apparatus, this necessitated observing the resonances in a flop-out manner. Resonances were observed at several values of static magnetic field up to about 5 gauss. The measured resonance frequencies are consistent only with $\Delta F = 0$ transitions within the states $J = \frac{3}{2}$, $I = 2$, $F = \frac{1}{2}$, and $J = \frac{3}{2}$, $I = 2$, $F = \frac{5}{2}$, indicating that the spin of this odd-odd nucleus, in its 27-hour ground state, is 2. At the higher fields used, splittings of the resonances were observed, which were attributed to multiple quantum transitions within both $F = \frac{5}{2}$ and $F = \frac{1}{2}$ multiplets. By an analysis of these resonances, the hyperfine constants (in Mc/sec) were determined to be: $A = -33.1 \pm 1.5$, and $B = -1.2 \pm 6$; or $A = +29.5 \pm 1.5$ and $B = +16 \pm 16$. The experimental data showed a slight, but not unimpeachable, preference for the negative sign. In either case, it was found that $g_J = 1.994 \pm 0.003$. (auth)

15276 ORNL-2919

Oak Ridge National Lab., Tenn.
THE ANGULAR DISTRIBUTION OF ALPHA PARTICLES EMITTED BY ORIENTED Np^{237} NUCLEI (thesis). S. H. Hanauer, J. W. T. Dabbs, L. D. Roberts, and G. W. Parker. May 10, 1960. 84p. Contract W-7405-eng-26. OTS.

Submitted to the Univ. of Tenn.

Neptunium-237 nuclei were aligned when a monocrystalline sample of neptunyl rubidium nitrate was cooled to 0.2 to 4.2°K. The rotatable sample was placed in a capsule filled with He^3 gas for heat transfer. Also in the capsule were a germanium surface-barrier alpha-particle counter, a thermometer, and rotation indicators. The capsule was in thermal contact with $\frac{1}{2}$ mole of manganous ammonium sulfate hexahydrate for cooling by adiabatic demagnetization. At all temperatures in the range studied, the alpha particles were observed to be emitted preferentially perpendicular to the crystalline c axis. Comparison of the temperature variation of the anisotropy with predictions from an experimentally determined spin Hamiltonian made possible an unambiguous assignment, $A < 0$, $P > 0$, of the signs of the hyperfine coupling constants in neptunyl rubidium nitrate. These sign assignments and the experimentally observed preferred direction for alpha-particle emission place current ideas about the electronic structure of uranyl-like ions in conflict with a simple barrier-penetration picture of alpha-particle emission. (auth)

15277 TID-5787

Los Alamos Scientific Lab., N. Mex.
FISSION YIELDS OF Sr^{90} . B. P. Bayhurst. [1957?] Decl. Oct. 28, 1957. 3p. Contract [W-7405-eng-36]. OTS.

Fission yields were determined from 14-Mev neutrons

on U^{235} and U^{238} , thermal neutrons on U^{235} , and fission spectrum neutrons on U^{235} , U^{238} , and Pu^{239} . The number of fissions was determined for the Mo^{99} activity. The Sr^{90} was chemically separated and Y^{90} allowed to reach equilibrium. The Y^{90} was separated and counted. (W.D.M.)

15278 TID-5820

Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.

SOME OPTICAL MODEL CALCULATIONS. Technical Report No. 73. E. J. Campbell, H. Feshbach, C. E. Porter, and V. F. Weisskopf. Feb. 8, 1960. 496p. Contracts Nonr-1841-(16) and AT(30-1)-2098.

The various numerical results consequent to the fitting of low-energy neutron-nucleus cross sections by a complex potential model are tabulated. The complex potential is the familiar Saxon-Woods potential. In addition to the computed theoretical values of the cross sections and of the angular distributions, the tables give the imaginary parts of the cotangent of the phase shift for each value of the orbital angular momentum as well as the partial shape elastic cross section and the partial cross section for the formation of the compound nucleus. (W.D.M.)

15279 AERE-Trans-839

THE NUCLEAR ABSORPTION CROSS-SECTION FOR GAMMA RAYS BETWEEN 10 AND 30 MEV. B. Ziegler. Translated by E. Franklin (U.K.A.E.A. Atomic Energy Research Establishment) from *Z. Physik* **152**, 566-73(1958). 12p.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 13, as abstract No. 1735.

15280

REDUCED WIDTHS FOR A NUCLEON EMISSION ACCORDING TO NILSSON'S MODEL. M. Micu and A. Săndulescu. *Acad. rep. populare Romîne, Inst. fiz. atomică și Inst. fiz. Studii cercetări fiz.* **10**, 651-7(1959). (In Rumanian)

Reduced widths for a single nucleon emission are calculated. The nuclear wave function is separately anti-symmetrical with respect to neutrons and protons, the individual wave functions being those given by Nilsson. Theoretical results are compared with experimental data for a few light nuclei. (auth)

15281

EXCITATION OF NUCLEI BY THE QUADRUPOLE MOMENT OF THE PROJECTILE. M. Micu. *Acad. rep. populare Romîne, Inst. fiz. atomică și Inst. fiz. Studii cercetări fiz.* **10**, 659-71(1959). (In Rumanian)

The contribution to the Coulomb excitation by the quadrupole moment of the projectile is studied by considering the transitions caused by the static interaction between this moment and the target nuclei. The expressions of the cross section and of the function of angular distribution of the γ de-excitation radiation are indicated. The results obtained are significant for collisions in which the energy passes the energy limit necessary for the existence of a pure Coulomb excitation. (tr-auth)

15282

DISINTEGRATION OF ORIENTED NUCLEI BY ELECTRON CAPTURE. A. Gelberg. *Acad. rep. populare Romîne, Inst. fiz. atomică și Inst. fiz. Studii cercetări fiz.* **10**, 785-90(1959). (In Rumanian)

The diffusion cross section of the fluorescence of gamma rays emitted after disintegration by electron capture of oriented nuclei was calculated. Such results permit the obtention of information on beta interaction. The Doppler displacement of the gamma-ray frequency, caused by nuclear recoil, was considered. It is shown that it is sufficient to measure the cross section for two directions of opposed orientation to obtain the possibility of choosing between the ST and VA variants of the interaction hamiltonian. (tr-auth)

15283

REMARKS ON THE POSSIBLE STRUCTURE OF NUCLEI AND CERTAIN ELEMENTARY PARTICLES (BARYONS). Theophile T. Vescan. *Analele ştiinţ. univ. "Al. I. Cuza" Iasi, Sect. I, [N.S.]* **3**, No. 1-2, 257-62(1957). (Translated from *Referat. Zhur. Fiz.* No. 9, 1959, Abstract No. 19669).

The classical interaction of nucleons with dipole and quadrupole nuclear fields is considered. To obtain data on the distribution of the density of matter in the nucleus, the motion of relativistic classical particles is calculated in a spherically-symmetrical potential of the form $W(r) = g^2 \exp\{-k_r r\}/r$.

15284

INTERNAL CONVERSION SPECTRUM OF Pt^{192} AND Os^{192} . L. Marinkov, M. Mladenović, M. Župančić, and R. Stepić. *Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade)* **10**, 7-13(1960) Mar. (In English)

The internal conversion spectrum of Pt^{192} and Os^{192} was measured and 50 conversion lines were found. The measurements were made with a 50-cm radius iron-free double focusing spectrometer, a large permanent magnet spectrometer, and an iron-clad lens. (auth)

15285

EXTERNAL CONVERSION SPECTRUM OF Pt^{192} GAMMA-RAYS FROM THE DECAY OF Ir^{192} . M. Mladjenović, T. Novakov, and M. Župančić. *Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade)* **10**, 15-17(1960) Mar. (In English)

The relative intensities of some gamma transitions in Pt^{192} were measured by the external conversion method in U with the large 50-cm radius iron-free double focusing beta-ray spectrometer. (auth)

15286

ON THE AXIAL SYMMETRY OF THE NILSSON MODEL NUCLEUS. T. D. Newton (Atomic Energy of Canada Ltd., Chalk River, Ont.). *Can. J. Phys.* **38**, 700-8(1960) May.

The shape of the oscillator potential necessary to give the minimum energy for a system of single fermions in an anisotropic oscillator with Nilsson spin-orbit coupling is calculated. The number of particles is limited to 50 or less and is even. The preferred distortion parameters (β and γ) are plotted vs. number of particles, and energy maps (energy vs. β) are given for various amounts of spin-orbit coupling. Implications of the calculations, e.g., that the Bohr strong coupling approximation and the Davydov-Filippov model cannot easily be justified, are discussed. (D.L.C.)

15287

REFLECTIONS ON THE THEORETICAL INTERPRETATION OF CATALYZED NUCLEAR REACTIONS. Simone Vuccino (Institut des Hautes Études, Tunis). *Compt. rend.* **250**, 2702-4(1960) Apr. 11. (In French)

The theory proposed by several authors for the interpretation of catalyzed nuclear reactions is discussed. In the present work the weaknesses of the theory which compares the study of the mesic molecule to that of the hydrogen atom are shown. Some improvements are proposed for the calculations with a better precision of the nuclear wave function. (tr-auth)

15288

RESONANCE SCATTERING OF THE 23.8-KEV γ RADIATION

TION EMITTED WITHOUT RECOIL FROM Sn^{119} . Roland Barloutaud, Jean-Loup Picou, and Christophe Tzara (Centre d'Études nucléaires, Saclay, France). Compt. rend. **250**, 2705-7(1960) Apr. 11. (In French)

Photons re-emitted by Sn^{119} after resonance absorption of photons emitted without recoil by Sn^{119} were observed. The value of the Debye-Waller factor, at approximately 90°K, measured with this method is in good agreement with that measured by transmission. (tr-auth)

15289

DETERMINATION OF THE CROSS SECTIONS OF THE REACTION $D + D = p + T + 4.03 \text{ Mev}$ AT ENERGIES LESS THAN 15 kev. D. Magnac-Vallete, E. Lacombe, R. Bilwes, and P. Clier (Faculté des Sciences, Strasbourg). J. phys. radium **21**, 125-6(1960) Feb. (In French)

Values of the cross sections of the reaction $D + D \rightarrow p + T$ are measured below 15 Mev with a thick target containing absorbed deuterium. These cross sections are necessary in thermonuclear calculations. (auth)

15290

THE REACTIONS $\text{Li}^7(p,n)\text{Be}^7$, $\text{B}^{11}(p,n)\text{C}^{11}$ AND $\text{Al}^{27}(p,n)\text{Si}^{27}$ AT 8 TO 14 Mev. Kazuo Hisatake, Yoshihide Ishizaki, Akira Isoya, Teruo Nakamura, Yoshihiro Nakano, Bunsaburo Saheki, Yoshio Saji, and Kazunori Yuasa (Tokyo Univ.). J. Phys. Soc. Japan **15**, 741-8(1960) May. (In English)

The (p,n) reactions for lithium, boron, and aluminum targets were studied using proton-recoil, fast-neutron spectrometers. The angular distributions of $\text{Li}^7(p,n)\text{Be}^7$ neutrons corresponding to the ground and the 0.43 Mev excited states at 8.1 to 14.1 Mev and corresponding to the 4.65 Mev excited state of Be^7 at 14.1 Mev were obtained. Using the activation method, the excitation curve of this reaction was observed with a 15 Mev proton beam. The angular distributions of neutrons from the reaction $\text{B}^{11}(p,n)\text{C}^{11}$ (the ground state) at 8.1 to 14.1 Mev and from the reactions $\text{Al}^{27}(p,n)\text{Si}^{27}$ (the ground and the excited states) at 14.1 Mev were also observed. The theory of Austern, Butler, and McManus does not agree with the obtained results in the case of the reaction $\text{B}^{11}(p,n)\text{C}^{11}$, but agrees with that in the reaction $\text{Al}^{27}(p,n)\text{Si}^{27}$. It was observed that, for the reaction $\text{B}^{11}(p,n)\text{C}^{11}$, the isotropic parts of the angular distributions of neutrons became larger as the incident proton energies decreased and, in the cases of the reactions of $\text{Li}^7(p,n)\text{Be}^7$ and $\text{B}^{11}(p,n)\text{C}^{11}$, the angular distributions of neutrons showed large variations for the different proton energies. (auth)

15291

MEASUREMENTS OF THE POLARIZATION IN PROTON-HELIUM ELASTIC SCATTERING. Junpei Sanada, Keigo Nisimura, Shigeki Suwa, Izuo Hayashi, Kiyoji Fukunaga, Norio Ryu, and Masao Seki (Tokyo Univ.). J. Phys. Soc. Japan **15**, 754-9(1960) May. (In English)

The polarization of protons elastically scattered by helium was measured by the double scattering method. Incident proton or alpha-particle beam was obtained from the INSJ 160-cm variable energy cyclotron. Three interdependent measurements, in which the polarization product was equal to P_1P_2 , P_2P_3 , or P_3P_1 , were made. The following results were obtained: $P_1(6.2 \text{ Mev}, 130.0^\circ) = 0.92 \pm 0.11$; $P_2(11.5 \text{ Mev}, 61.1^\circ) = -0.45 \pm 0.06$; and $P_3(9.1 \text{ Mev}, 61.1^\circ) = -0.45 \pm 0.06$, where angles and energies are those in the center-of-mass system. Experimental values of the polarization agreed well to the values calculated by using phase shifts, which were obtained from the analysis of the angular distribution of the scattering cross sections. (auth)

15292

ELASTIC AND INELASTIC SCATTERING OF PROTONS FROM N, Ne, Mg, Si, S AND Ar IN THE ENERGY RANGE FROM 7.6 Mev TO 14.2 Mev. Yukiyasu Oda, Minoru Takeda, Naoyuki Takano, Takashi Yamazaki, Chuin Hu, Ken Kikuchi, Shinsaku Kobayashi, Kazuhisa Matsuda, and Yukio Nagahara (Tokyo Univ.). J. Phys. Soc. Japan **15**, 760-71(1960) May. (In English)

The angular distributions of protons scattered elastically and inelastically by N, Ne, Mg, Si, S, and Ar nuclei were studied at several values of proton energy from 7.6 to 14.2 Mev. The distribution shapes for elastic scattering show general diffraction patterns at $E_p > 10 \text{ Mev}$. While the yields of inelastic scattering corresponding to the second excited state of N^{14} are appreciable at higher energies, the yields for the first excited state with $T = 1$ are markedly low. The inelastic scatterings for the first excited states of Ne^{20} , Mg^{24} , and Si^{28} are found to change their distribution shapes appreciably with proton energy. The excitation functions of the reaction for Si^{28} were also studied. The results show prominent resonance features. These results seem to support the proposition that the formation of a compound nucleus plays an appreciable role in the inelastic scattering from these light nuclei, especially at the lower energy. The distribution shapes of the inelastic scattering from S^{32} are fairly insensitive to energy change. Further, the inelastic scattering of protons from Ar^{40} shows quite a different feature from those mentioned above. The angular distribution shapes and their energy dependences resemble much those obtained for medium weight even-even nuclei. (auth)

15293

THEORY OF THE NUCLEAR MAGNETIC RESONANCE OF Co^{59} IN CoO . Kazuko Motizuki (Osaka Univ.). J. Phys. Soc. Japan **15**, 888-96(1960) May. (In English)

The NMR of Co^{59} in CoO is calculated, taking into account the interaction between the nuclear spin and the spin moment and residual orbital moment of the cobalt ion, along with the Fermi-type hyperfine interaction. The calculated frequency is 1028 Mc. The interaction between the nuclear quadrupole moment, Q , and the electric field gradient at the nucleus splits this resonance line into seven equally spaced lines. For an assumed value of $Q = 0.5 \times 10^{-24} \text{ cm}^2$, the line splitting is 6 Mc. The dependence of the frequency of the resonance lines on the direction of the applied field is also investigated. It is shown that by observing this dependence the angle of inclination of the spin axis to the tetragonal axis can be deduced. Further, theory of the indirect coupling between nuclear spins through hyperfine interaction and exchange interaction is developed using the molecular field approximation. The line width arising from this indirect coupling is estimated to be 0.115 Mc, which is small compared with the line splitting. (auth)

15294

ON THE ALPHA-PARTICLES FROM THE $\text{N}^{14}(d,\alpha)\text{C}^{12}$ GROUND STATE REACTION. Nawoyuki Kawai (Kyushu Univ., Fukuoka). J. Phys. Soc. Japan **15**, 930(1960) May. (In English)

The angular distributions of α particles from the $\text{N}^{14}(d,\alpha)\text{C}^{12}$ ground state reaction were measured in the deuteron energy range of 1.4 to 2.9 Mev. The peaks from the above reaction were easily separated from the proton groups from $\text{N}^{14}(d,p)\text{N}^{15}$ and $\text{C}^{12}(d,p)\text{C}^{13}$ reactions at angles up to 105°, but above 105° masking occurred. The angular distribution graphs show minima at $\sim 80^\circ$ and a gradual rise beyond 80°; this is consistent with the results of Booth and

Gibson. It is concluded that the (d, α) reaction proceeds by direct interaction as well as compound nucleus formation in this low deuteron energy region. (D.L.C.)

15295

SPIN ORDER IN THE DOUBLET AT THE SECOND EXCITED LEVEL IN EVEN-EVEN MEDIUM NUCLEI. Mitsuo Sakai (Tokyo Univ.). *J. Phys. Soc. Japan* **15**, 933(1960) May. (In English)

A method is given for the prediction of the position of the unknown spin level in the second excited state doublet commonly encountered in medium weight even-even nuclei. Data on all such nuclei known to have this doublet were plotted on an energy ratio graph of $E_1(4)/E_2(2)$ vs. $E_2(2)/E_1(2)$, where $E_2(2)$ is the energy of the 2^+ level in the second excited state with respect to the first excited state, etc., and found to fit closely a smooth curve. This graph could be used in finding the second level of the doublet in such cases where the first level and the lower excited state are known. Also included on the graph is the curve expected from the asymmetric rotor theory (Davydov and Filippov, et al.); it is similar in shape to the experimental curve, but is displaced upward, in contrast with data for heavy nuclei, which fits the theoretical curve quite well. (D.L.C.)

15296

RECOIL TECHNIQUE IN CYCLOTRON BOMBARDMENTS USING POWDER TARGETS. G. Andersson, G. Rudstam, and T. Stenström (Univ. of Uppsala). *Nuclear Instr. & Methods* **7**, 73-5(1960) Apr. (In English)

A new bombardment technique based on the catching of recoils in targets of mixed powders facilitates the carrier-free separation of cyclotron-produced nuclides. The method is applicable even to isotopes of the target element. In preliminary experiments useful yields were about 10% of those obtainable from a pure target. (auth)

15297

ISOMERISM OF SILVER-108. Morris A. Wahlgren and W. Wayne Meinke (Univ. of Michigan, Ann Arbor). *Phys. Rev.* **118**, 181-3(1960) Apr. 1.

A long-lived isomer of Ag^{108} was detected in old $\text{Ag}^{110\text{m}}$ samples. The isomer decays with a half-life ≥ 5 years. Gamma- and beta-ray spectrometer data show that 90% of the disintegrations proceed by electron capture followed by a cascade of three gamma rays of 616-, 722-, and 434-kev energy, while 10% go by isomeric transition to Ag^{108} . New values are given for the branching ratios of 2.4-minute Ag^{108} . (auth)

15298

SPIN STATES ASSOCIATED WITH NEUTRON RESONANCES IN In^{115} . A. Stolovy (U. S. Naval Research Lab., Washington, D. C.). *Phys. Rev.* **118**, 211-16(1960) Apr. 1.

The spin states of the first three slow neutron resonances in the target nucleus In^{115} were measured. These were obtained by polarizing both the neutron beam and the nuclear sample, and observing the direction of change in the transmitted intensity upon reversing the polarization of the neutrons with respect to the target nuclei. The spin states associated with the resonances at 1.46, 3.86, and 9.10 ev were found to be $J = 5, 4$, and 5 , respectively. These spin assignments are consistent with measurements of other parameters of these resonances. (auth)

15299

PHOTODISINTEGRATION OF Li^6 . D. G. Proctor and W. H. Voelker (Case Inst. of Tech., Cleveland). *Phys. Rev.* **118**, 217-21(1960) Apr. 1.

The photodisintegration of Li^6 by bremsstrahlung radiation of 17.3-Mev peak energy was investigated by use of coincidence techniques to detect neutron-proton coincidences and by measurement of the photo-proton energy spectra. The $\text{Li}^6(\gamma, n)\text{Li}^5$ reaction is found to be responsible for 0.58 ± 0.13 of the photo-neutron yield measured by Romanowski while the $\text{Li}^6(\gamma, p)\text{He}^5$ reaction contributes 0.31 ± 0.04 of the yield. No angularly correlated neutron-proton coincidences were detected which would support a deuteron-alpha-particle model for the $\text{Li}^6(\gamma, np)\text{He}^5$ reaction; however, the possible existence of this reaction is not eliminated. (auth)

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15300

ENERGY LEVELS IN Ne^{20} FROM THE $\text{F}^{19}(\text{d}, \text{ny})\text{Ne}^{20}$ REACTION. J. W. Butler (U. S. Naval Research Lab., Washington, D. C.). *Phys. Rev.* **118**, 222-7(1960) Apr. 1.

The gamma-ray threshold technique was used with the $\text{F}^{19}(\text{d}, \text{ny})\text{Ne}^{20}$ reaction to find excited states in the residual nucleus, Ne^{20} . Thin targets of CaF_2 were bombarded with deuterons from a 2-Mv Van de Graaff accelerator. Two $\text{NaI}(\text{Tl})$ crystals (1.75-in. \times 1.75-in. and 3-in. \times 3-in.) were used in a coincidence arrangement to measure the gamma rays as a function of deuteron energy. Nine gamma-ray or neutron thresholds were found, at bombarding energies of 0.51 ± 0.02 , 0.60 ± 0.02 ?, 0.76 ± 0.02 , 0.85 ± 0.02 ?, 1.15 ± 0.02 , 1.35 ± 0.02 , 1.70 ± 0.02 , 1.79 ± 0.02 , and 2.06 ± 0.02 Mev. These threshold energies correspond to excited states in Ne^{20} at 11.11 ± 0.02 , 11.19 ± 0.02 ?, 11.33 ± 0.02 , 11.42 ± 0.02 ?, 11.69 ± 0.02 , 11.87 ± 0.02 , 12.19 ± 0.02 , 12.27 ± 0.02 , and 12.51 ± 0.02 Mev, respectively. All of these states decay principally to the ground state of Ne^{20} except the 11.11-, 11.19-, and 12.27-Mev states, which decay primarily to the 1.63-Mev state. Possible isobaric spin assignments are discussed. (auth)

15301

RADIOACTIVE DECAY OF Lu^{168} . R. G. Wilson and M. L. Pool (Ohio State Univ., Columbus). *Phys. Rev.* **118**, 227-8(1960) Apr. 1.

Ytterbium oxide enriched to 30.9% in the 168 mass number was irradiated with 6-Mev protons. An activity decayed by electron capture with a half-life of 7.1 ± 0.2 minutes was produced and assigned to Lu^{168} . The activity consists of gamma rays with energies of 87 ± 1 , 900 ± 7 , 987 ± 7 , 1410 ± 20 , 1800 ± 40 , and 2130 ± 60 kev in addition to the ytterbium K x ray. An energy level scheme for this decay is presented. (auth)

15302

CROSS SECTIONS FOR THE $(n, 2n)$ REACTION IN N^{14} , P^{31} , Cu^{63} , AND Pr^{141} . J. M. Ferguson and W. E. Thompson (U. S. Naval Radiological Defense Lab., San Francisco). *Phys. Rev.* **118**, 228-32(1960) Apr. 1.

The $(n, 2n)$ cross sections were measured for N^{14} , P^{31} , Cu^{63} , and Pr^{141} for neutron energies from 12.5 to 18 Mev. The annihilation radiation emitted from the product nuclides was counted with two $\text{NaI}(\text{Tl})$ crystals in coincidence. In the energy range measured, the cross sections were found to vary, as follows: N^{14} , 3.03 to 11.67 mb; P^{31} , 0 to 74 mb; Cu^{63} , 186 to 836 mb; Pr^{141} , 1231 to 1737 mb. The results are generally in agreement with those of others. The data are compared with curves plotted from Weisskopf's theoretical expression for $(n, 2n)$ cross sections. (auth)

15303

NUCLEAR SPIN OF SAMARIUM-153. Amado Cabezas, Edgar Lipworth, Richard Marrus, and Joseph Winocur (Univ. of California, Berkeley). *Phys. Rev.* **118**, 233-4(1960) Apr. 1.

The atomic-beam magnetic-resonance method was used to measure the nuclear angular momentum of 47-hour Sm^{153} . It is found that $I = \frac{3}{2}$. (auth)

15304

NUCLEAR PAIR EMISSION FROM THE 7.656-Mev LEVEL IN C^{12} . David E. Alburger (Oak Ridge National Lab., Tenn. and Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **118**, 235-42(1960) Apr. 1.

The 7.656-Mev nuclear pair transition from the 0^+ second excited state of C^{12} was observed in the $\text{Be}^9(\alpha, n)\text{C}^{12}$ reaction by means of an intermediate-image pair spectrometer. With a beam of 5.81-Mev alpha particles incident on a 0.7-Mev thick Be foil target the observed intensity ratio of the 7.656-Mev pair line to the 4.433-Mev pair line from the 2^+ first excited state of C^{12} was $(5 \pm 1.5) \times 10^{-4}$. Approximately the same intensity ratio was found with both 5.38- and 5.81-Mev alpha particles incident on thick (6 mg/cm²) Be targets. By applying the appropriate factors for the spectrometer efficiency and for the internal pair conversion coefficient of the 4.433-Mev transition the derived ratio of pair to total widths of the 7.656-Mev level is $\Gamma_{e^+e^-}/\Gamma = 8.2 \times 10^{-7} \times R$ where $R = N_{4.433}/N_{7.656}$, the ratio of neutron populations in the $\text{Be}^9(\alpha, n)\text{C}^{12}$ reaction. As a rough estimate R is assumed to be ~ 8 based on the only information available. This leads to $\Gamma_{e^+e^-}/\Gamma \sim 7 \times 10^{-6}$ which is a factor of ~ 15 smaller than estimates by Cook et al. in which the width Γ_α for the alpha-particle decay of the level was taken as $\frac{1}{10}$ of the Wigner limit. The most plausible explanation of the data is that Γ_α is close to the Wigner limit. (auth)

15305

ACTIVATION CROSS SECTIONS FOR 14.8-Mev NEUTRONS AND SOME NEW RADIOACTIVE NUCLIDES IN THE RARE EARTH REGION. R. G. Wille and R. W. Fink (Univ. of Arkansas, Fayetteville). *Phys. Rev.* **118**, 242-8(1960) Apr. 1.

Activation cross sections on 27 stable nuclides of elements Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Dy, Er, Yb, and Lu were measured for 14.8 ± 0.8 -Mev neutrons. Highly enriched isotopes were used as targets in most cases, and in a few instances radiochemical separations were performed whenever it was necessary and possible in view of the product half-lives. The measured cross sections for (n,2n) reactions were found to agree within an order of magnitude with predictions from statistical evaporation theory. However, experimental values of (n,p) and (n, α) cross sections generally appear to be larger than calculated from continuum theory of the compound nucleus. The cross sections show no significant effects due to the 82-neutron closed shell and, furthermore, the Levkovskii effect, which is quite striking in the low Z region, appears to be negligible for (n,p) and (n, α) reactions in the rare earth region. The (n,2n) cross sections show little variation with mass number at constant Z, and they exhibit a decrease with increasing mass number at $N = 82$. Several previously unreported activities were observed; their half-lives, assignment, and gamma radiations are as follows: 12 ± 3 min Pr^{148} from the Nd^{148} (n,p) reaction; 0.5 ± 0.1 min Sm^{151} from the Gd^{160} (n, α) reaction, 0.57 ± 0.01 Mev gamma; 7 ± 1 min Tb^{163} from the Dy^{163} (n,p) reaction, 0.18 ± 0.05 -Mev gamma; 3.3 ± 0.5 min Ho^{166} from the Er^{168} (n,p) reaction, 0.85 ± 0.05 -Mev gamma; 40 ± 10 sec Ho^{170} from the Er^{170} (n,p) reaction; 4.4 ± 0.4 min Dy^{167} from the Er^{170} (n, α) reaction; 2.0 ± 0.5 min activity with gammas at 0.18 ± 0.01 , 0.25 ± 0.01 , and 0.36 ± 0.01 Mev which may be Tm^{176} , Er^{173} , or possibly isomeric Yb^{177m} from enriched Yb^{176} bombardments. Tentative assignment of a 5.5 ± 0.5 -min activity to Tm^{174} is suggested from bombardment of enriched Yb^{174} . (auth)

15306

DECAY OF Be^9 (2.43-Mev STATE). E. M. Henley and P. D. Kunz (Univ. of Washington, Seattle). *Phys. Rev.* **118**, 248-62(1960) Apr. 1.

The decay of the 2.43-Mev state of Be^9 is treated theoretically. Of the open two-body decay channels all but one involve a nuclear state, the energy of which is not well defined. The usual formalisms were generalized to take this into account. The estimate of the decay rates is made by means of a variational internal wave function for the Be^{9*} state, based upon the alpha-particle model. It is found that the principal mode of decay is to $\text{He}^5 + \text{He}^4$. Model-dependent arguments are given to show that decay to the ground state of Be^8 should be inhibited. Furthermore, the momentum and angular distributions of alphas emitted in the decay through several two-particle decay modes are computed. These latter calculations do not assume any specific nuclear model, but depend on the weak assumption that the state is excited by a direct reaction. Comparison with recent measurements indicates that in addition to the $\text{He}^5 + \text{He}^4$ decay, approximately 7% of the decay occurs to the ground state of Be^8 , which is consistent with our calculations. (auth)

15307

ISOTOPES Np^{240} AND Np^{241} . Richard M. Lessler and Maynard C. Michel (Univ. of California, Berkeley). *Phys. Rev.* **118**, 263-4(1960) Apr. 1.

The 1-hour neptunium activity which had previously been assigned to Np^{241} was identified as the lower isomer of Np^{240} . The decay energy of the 1-hour Np^{240} was found to be 2.05 Mev compared with 2.18 Mev for that of the 7.3-min Np^{240} . Gamma rays of energies 1160, 1000, 915, 595, 565, 435, 245, 160, and 85 kev were found to be associated with the decay of Np^{240} . The best value for the half-life of Np^{240} is 63 ± 2 min. The isotope Np^{241} was found to have a 16-min half-life with strong evidence for an isomer with a 3.4 -hour half-life. (auth)

15308

NEW NEUTRON-DEFICIENT ISOTOPES OF TANTALUM. K. T. Faler and J. O. Rasmussen (Univ. of California, Berkeley). *Phys. Rev.* **118**, 265-9(1960) Apr. 1.

Bombardment of Ho_2O_3 with N^{14} ions in the Berkeley heavy-ion linear accelerator resulted in the discovery of new isotopes of tantalum which have been assigned as Ta^{173} and Ta^{174} . They have half-lives of 3.7 hr and 1.3 hr, respectively. Tantalum-172 was not observed and is believed to have a half-life shorter than 30 minutes. Gamma-ray spectra were obtained for these two isotopes and for Ta^{175} . Tantalum-175, with an 11-hr half-life, was also produced by 48-Mev alpha-particle bombardment of Lu_2O_3 , and its conversion-electron spectrum was studied. From these data a decay scheme is proposed using nine of the observed transitions and assigning spins to three members of the ground-state rotational band. (auth)

15309

CHARGE-EXCHANGE CROSS SECTION OF 175- TO 250-MEV K^+ IN CARBON, COPPER, TUNGSTEN, AND NUCLEAR EMULSION. Marian N. Whitehead, Robert E. Lanou, Jr., Victor Cook, Jr., and Robert W. Birge (Univ. of California, Berkeley). *Phys. Rev.* **118**, 300-8(1960) Apr. 1.

The disappearance and presumed charge exchange of K^+ mesons was previously observed in nuclear emulsions. The charge-exchange cross section for K^+ energies between 150 and 250 Mev in C, Cu, W, and, as a check, in nuclear emulsion was measured. In addition, a scintillation-counter array was used to detect the charged decay mode of the

short-lived K_1^0 produced in the charge-exchange reaction. The measured mean free path in nuclear emulsion is 195 ± 25 cm at 200 Mev. The average corrected free-neutron cross section deduced from the pure elements is 5.9 ± 0.4 mb. From K^+ charge exchange, and assuming a branching ratio of $\frac{1}{3}$ for decay into the $2\pi^0$ mode compared to all decays for the K_1^0 state, a K_1^0/K_2^0 ratio was found to be consistent with unity. (auth)

15310

ABSORPTION OF NEGATIVE MUONS IN C^{12} LEADING TO PRODUCTION OF BOUND B^{12} . J. G. Fetkovich, T. H. Fields, and R. L. McIlwain (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. **118**, 319-24(1960) Apr. 1.

A negative muon beam from the Carnegie Tech synchrocyclotron was stopped in a six-inch propane bubble chamber. Since the hydrogen does not form μ -mesonic atoms in the presence of carbon, the pictures yield information on the interaction of stopped muons with carbon. About 30,000 pictures of stopping muons were taken with the bubble chamber kept sensitive for ~ 20 msec after the beam pulse in order to observe the beta decay of any bound B^{12} nuclei resulting from μ absorption by carbon. The chamber was photographed right after the beam pulse to determine whether a given stopped muon decayed or was absorbed. Another photograph was taken about 15 msec later to determine if the absorption had led to a nucleus which had beta decayed. A count of μ -e decays in the same film allowed the determination of the probability per unit time of bound B^{12} formation. Forty-six boron decays were observed yielding $(7.6 \pm 1.2) \times 10^5 \text{ sec}^{-1}$ for the rate of bound B^{12} production. Possible interpretation of this result in terms of a universal V-A Fermi interaction is discussed. (auth)

15311

TOTAL CROSS SECTIONS OF THE $O^{18}(p,\alpha)N^{15}$ AND $O^{18}(p,n)F^{18}$ REACTIONS. J. M. Blair and J. J. Leigh (Univ. of Minnesota, Minneapolis). Phys. Rev. **118**, 495-8(1960) Apr. 15.

The angular distribution of the α particles from the $O^{18}(p,\alpha)N^{15}$ reaction and the total cross section for the $O^{18}(p,n)F^{18}$ reaction have been measured for proton energies between 2.60 and 2.97 Mev. Comparison of the total cross sections for the two reactions eliminates the previously observed differences in resonance energies in these reactions. At most energies the α particles are preferentially emitted in the forward and backward directions and the angular distributions are rapid functions of proton energy. (auth)

15312

ENERGY SPECTRA OF PROTONS FROM (d,p) REACTIONS IN HEAVY ELEMENTS. B. L. Cohen, J. B. Mead, R. E. Price, K. S. Quisenberry, and C. Martz (Univ. of Pittsburgh). Phys. Rev. **118**, 499-506(1960) Apr. 15.

Surveys of proton energy distributions from (d,p) reactions were made on nuclei with $Z > 30$ using resolutions of 500 and 80 kev. The gross structure shows broad peaks due to the major nuclear shells, as expected from the fact that (d,p) stripping reactions excite single-particle states; peaks due to the subshell structure can be seen in some cases, especially in the heavier nuclei. The energies of the various peaks do not shift from element to element in the manner expected from simple theory; it is shown that this is not in conflict with neutron cross-section evidence, and possible explanations are proposed. The energy spacing between major shells derived from these measurements allows calculation of the reduced mass for nucleons in nuclei; the result is very different from the predictions of Brueckner theory, but explanations for this

discrepancy are advanced. The results and their interpretation given here are in direct conflict with the Wilkenson theory of gamma-ray giant resonances. The energy spectra are very similar at different angles, which indicates that the stripping process is predominant at all angles. Deviations from Butler angular distribution theory at large angles must therefore be due to difficulties in that theory rather than due to the onset of competing process. (auth)

15313

NEUTRON PRODUCTION BY HEAVY-ION BOMBARDMENTS. Edward L. Hubbard, Robert M. Main, and Robert V. Pyle (Univ. of California, Berkeley). Phys. Rev. **118**, 507-14(1960) Apr. 15.

Neutron yields from C^{12} , N^{14} , and Ne^{20} bombardments of a number of target elements have been measured by an activation method. The maximum bombarding energies were 10.4 Mev per nucleon of the incident ion. Neutron yields have been calculated by assuming complete fusion of the two nuclei, with an interaction radius of $r_0 \approx 1.5 \times 10^{-13}$ cm, followed by de-excitation of the compound nuclei by neutron emission only. Calculated neutron yields are a factor of about two higher than experiment in the case of heavy target nuclei, with greater differences for light targets. Some possible refinements of the theory that could bring the results closer to agreement with experiment are mentioned. (auth)

15314

NUCLEAR ENERGY LEVELS OF Na^{24} . Carl T. Hibdon (Argonne National Lab., Lemont, Ill.). Phys. Rev. **118**, 514-32(1960) Apr. 15.

The neutron cross section data up to 350 kev show a number of relatively large peaks and many smaller ones among the 86 peaks observed, the widths ranging from 0.2 to 6 kev. Approximately 50 small peaks were observed between 60 and 200 kev. Above 200 kev, each of the previously known peaks was resolved into two or more peaks and between these large peaks many narrower peaks were observed. The analyses show 9 s-wave levels and 46 p-wave levels, the remainder being d- and f-wave levels. A plot of the number of levels having energies $\leq E_n$ as a function of the neutron energy E_n shows an essentially linear distribution of the levels. As obtained from the reduced widths averaged over both values of J , the value of the strength function for $l = 0$ is 0.06; averaged over all values of J for $l = 1$ it is 0.65; and for higher values of l it is too large in comparison with the p-wave strength function. (auth)

15315

DIFFERENTIAL CROSS SECTIONS FOR NEUTRON RESONANCE SCATTERING FROM Na^{23} . R. O. Lane and J. E. Monahan (Argonne National Lab., Lemont, Ill.). Phys. Rev. **118**, 533-5(1960) Apr. 15.

The differential scattering cross section for neutrons on sodium has been measured with an energy spread of ~ 25 kev for neutron energies between 200 kev and 800 kev. The data are presented in the form of Legendre polynomial coefficients. (auth)

15316

PHOTONEUTRON CROSS SECTIONS OF Li , N , AND Ar . R. W. Fast, P. A. Flournoy, R. S. Tickle, and W. D. Whitehead (Univ. of Virginia, Charlottesville). Phys. Rev. **118**, 535-9(1960) Apr. 15.

Using a Halpern-type photoneutron detection system, the photoneutron yields from Li , N^{14} , and Ar^{40} were measured as a function of the maximum bremsstrahlung energy from threshold to approximately 50 Mev. The

method of Penfold and Leiss was used to extract from the yield curves the total neutron cross section; $\sigma_T = \sigma(\gamma, n) + \sigma(\gamma, pn) + 2\sigma(\gamma, 2n) + \dots$. The results are compared with previous findings of other laboratories. No gross structure was detected in the lithium cross section in the giant resonance region. The data indicate that lithium has a high-energy tail on the cross section of considerable magnitude. (auth)

15317

DEVIATIONS FROM THE $\Delta T = 0$ ISOTOPIC SPIN SELECTION RULE IN FERMION TRANSITIONS. Claude C. Bouchiat (Princeton Univ., N. J.). *Phys. Rev.* **118**, 540-6 (1960) Apr. 15.

Experimental deviations from the $\Delta T = 0$ isotopic spin selection rule have been observed experimentally in $J \rightarrow J$ beta transitions. In the theory of a vector interaction with a conserved current these deviations have to be explained only in terms of isotopic spin impurities, while in the conventional theory exchange mesonic currents may also induce Fermi transitions with $\Delta T \neq 0$. In this paper an attempt is made to estimate the contribution of the isotopic spin impurities arising from the Coulomb interaction between the protons. The $j-j$ coupling shell model is used to calculate the relevant Coulomb matrix elements. When all the nucleons outside the core are in the same orbit the main contribution comes from the Coulomb interaction between the protons outside the core. A comparison between the empirical Fermi matrix element M_F and the calculated one is performed in the case of Mn^{52} , Sc^{44} , and Na^{24} . The two quantities agree fairly well for the manganese-52. No such an agreement is found in the two other cases; the predicted M_F being too large for the sodium-24, too small for the scandium-44 at least by a factor ten. This discrepancy may reflect the inadequacy of the $j-j$ shell model to describe the Coulomb effects or the presence of mesonic effects. More experiments are needed to make a choice between these two possibilities. (auth)

15318

ISOMERIC LEVEL IN Pb^{206} FORMED IN THE DECAY OF Bi^{206} . Stanley H. Vegors, Jr., and R. L. Heath (Phillips Petroleum Co., Idaho Falls, Idaho). *Phys. Rev.* **118**, 547-53 (1960) Apr. 15.

An activity of 4.8-msec half-life which is assigned to Pb^{206m} has been observed in the electron capture decay of 14.5-day Bi^{206} . This isomeric level decays with the emission of 987.8, 703.3, and 284.4-keV gamma rays with relative transition intensities of 100, 10, and 10. No other gamma rays of energy greater than 10 keV were observed in the decay of this isomer. The 284.4- and 703.3-keV gamma rays are in coincidence but neither is in coincidence with the 987.8-keV transition. This evidence suggests that the 987.8-keV level de-excites directly to the ground state by the emission of a 284.4, 703.3 keV cascade with a 987.8-keV crossover. There is some evidence (not conclusive) that the 987.8-keV level itself may not be isomeric but that it may be fed entirely by a highly converted low-energy transition (<100 keV) from an isomeric level. (auth)

15319

ANGULAR DISTRIBUTION OF FRAGMENTS FROM THE FISSION OF BISMUTH BY 450-MeV PROTONS. M. V. Ramaniah and Nathan Sugarman (Univ. of Chicago). *Phys. Rev.* **118**, 562-3 (1960) Apr. 15.

Test experiments on the "bead-cone" method used for the measurement of the angular distribution of fission fragments from the 450-MeV proton fission of bismuth

were performed. These experiments make doubtful the conclusions of the previous measurement. (auth)

15320

SMALL-ANGLE PROTON SCATTERING AT 3 BEV. W. M. Preston, Richard Wilson, and J. C. Street (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* **118**, 579-88 (1960) Apr. 15.

The differential cross sections for elastic scattering of 3-Bev protons were measured with targets of hydrogen, carbon, copper, and lead over the angular range 0.5 to 4 degrees in the laboratory coordinate system. Within our limits of error, no evidence was found of Coulomb-nuclear interference with hydrogen, while with carbon there is indication of a real component of the nuclear scattering amplitude associated with a repulsive force. It is inferred from the extrapolated nuclear scattering cross section at zero degrees that appreciable scattering results from spin dependent forces with hydrogen but not with carbon. A derived value of the rms radius for p-p scattering exceeds that found in electron-proton scattering by a factor $\sqrt{2}$. (auth)

15321

NEUTRON SMALL-ANGLE SCATTERING BY SPIN WAVES IN IRON. R. D. Lowde and N. Umakantha (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Phys. Rev. Letters* **4**, 452-5 (1960) May 1.

The scattering of neutrons by spin waves in iron has been observed in virtual isolation at an intensity of several thousand counts per minute. The theoretical distribution of neutrons scattered near the primary beam by spin waves is given, assuming perfect collimation. By rotating the applied magnetic field through 90°, the expected spin-wave pattern was turned about the optical axis. The results of this were: (1) intensity having the anticipated angular dependence was present; (2) the expected curve of intensity variation was obtained; (3) absolute intensities were below those calculated for a simple Heisenberg-Bloch ferromagnet; (4) an absorption curve in silver indicated that the intensity differential cross section has the form λ^2 ; and (5) for some 54°K above room temperature the intensity was proportional to the absolute temperature, and the temperature increase was independent of the crystal setting. (B.O.G.)

15322

NUCLEAR SPIN RELAXATION IN SOLID He^3 . J. M. Goodkind and William M. Fairbank (Duke Univ., Durham, N. C.). *Phys. Rev. Letters* **4**, 458-60 (1960) May 1.

The nuclear spin relaxation times were measured in solid He^3 such that they might yield additional information as to the macroscopic properties which have been attributed to quantum effects. The measurements indicate: (1) In cases where the volume changes with $\alpha-\beta$ transition, there are large changes in the relaxation times. (2) In cases where the volume change approaches zero, there are no changes in the relaxation time across the boundary. If there are changes in the diffusion coefficients, there must be compensating changes in other relaxation mechanisms. (3) For temperatures above 1.37°K the α -phase behaves as an ordinary solid with a large diffusion coefficient. The relaxation is determined by an activated diffusion of atoms through the lattice. At temperatures somewhat below 1°K, the relaxation is much too fast to be explained by the classical diffusive motion of the Bloembergen, Purcell, and Pound theory. (B.O.G.)

15323

NUCLEAR GIANT DIPOLE RESONANCE. Keith A.

Brueckner and Reuben Thieberger (Univ. of California, La Jolla). Phys. Rev. Letters **4**, 466-8(1960) May 1.

The collective oscillation of neutrons and protons in nuclei which can be excited by an electromagnetic field leads to a resonant response of nuclei called the giant dipole resonance. A classical description is given since the oscillation for large wavelengths involves a large number of nucleons. Equations are given which exhibit the important feature that the single-particle energies in general will depend on the fluctuation in neutron-proton densities typical of the collective density oscillations. The role played in the nuclear symmetry energy by the change in potential energy resulting from density changes is emphasized. This effect gives about half the nuclear symmetry energy and gives an appreciable shift in the frequency of the collective oscillation. It is pointed out that a correct discussion of the collective motion starting from a single-particle approximation will lead to the classical result. (B.O.G.)

15324

ORDER OF LEVELS IN THE SHELL MODEL AND SPIN OF Be^{11} . I. Talmi and I. Unna (The Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev. Letters **4**, 469-70(1960) May 1.

The ground-state spin of Be^{11} is discussed in view of the proton configuration dependence of the order of filling neutron shells. Experimental data recently obtained indicate a spin and parity of $\frac{1}{2}^+$. It is shown that a $\frac{1}{2}^+$ spin of Be^{11} due to a $2s_{\frac{1}{2}}$ neutron is plausible and even preferred on the basis of the detailed quantitative scheme of the shell model. The competition between the $s_{\frac{1}{2}}$ and $p_{\frac{1}{2}}$ levels for Be^{11} , B^{12} , and C^{13} and the $d_{\frac{3}{2}}$ and $s_{\frac{1}{2}}$ levels for C^{16} , N^{16} , and O^{17} are given. The spin levels in Be^{11} and C^{15} resulted from linear extrapolations of the spin levels in the remaining isotopes for each group and other data. (B.O.G.)

15325

BICENTRAL MODEL OF NUCLEON COLLISIONS OF THE HIGHEST ENERGIES. J. Gierula. Postępy Fiz. **9**, 687-8 (1958) Nov.-Dec. (In Polish)

A statistical analysis of 119 observed cases of collisions (highest energies 10^{10} ev) in a nuclear emulsion reveals a systematic rise of secondary particle angular distribution anisotropy, manifested by a collimation of the particles around the direction of the axis of collision. Primary particles with an energy above 10^{12} ev diverged from the anisotropy type foreseen in the theories of Fermi, Landau, and Heisenberg. The observed anisotropy shows a non-uniformity of secondary particles in transverse directions to the direction of collision, which is a simple result of the relativistic collision kinematics. (JPRS)

15326

FISSION OF URANIUM-238 WITH μ^- MESONS. A. K. Mikhul and M. G. Petrashku (Joint Inst. for Nuclear Research, Dubna, USSR). Rev. phys. **4**, 355-8(1959). (In Russian)

The interaction of μ^- mesons at 150 Mev with U^{238} was investigated using nuclear emulsions. The experimental set-up and the development of the emulsion are described. Some 26,975 cases of the stopping of the mesons in the emulsion were investigated, and 59 cases of fission were observed. The fission probability was considered on the basis of the Fermi-Teller principle and of its independence from Z. The results are compared with previous results. (J.S.R.)

15327

OPTIMUM TARGET ORIENTATION IN NUCLEAR REACTIONS EXPERIMENTS. Jorge Rosenblatt (Comisión

Nacional de Energía Atómica, Buenos Aires). Rev. Sci. Instr. **31**, 578-9(1960) May.

The energy loss of the particle emitted (ΔE_0) from target bombardment due to energy loss in the target and to absorption of the energy loss of the incident particle (ΔE_a) is calculated as a function of the angles of the incident and emitted particles. The condition for zero energy spread over time t is given and is said to be undeterminable from E_0 , at least for light target nuclei. In the case of heavy nuclei, no correction is needed, for then $E_0 \approx E_a + \text{reaction energy}$. However, the correction formula is given for the general case. (D.L.C.)

15328

MÖSSBAUER EFFECT IN FERROCYANIDE. S. L. Ruby, L. M. Epstein, and K. H. Sun (Westinghouse Electric Corp., East Pittsburgh, Penna.). Rev. Sci. Instr. **31**, 580-1(1960) May.

Because ferrocyanide has no magnetic moment, it was investigated as an absorber in studies of the Mössbauer effect with Fe^{57} as source. The source was soft iron plated with Co^{57} and annealed; the 14.4-keV gamma ray from the vibrated source was passed through a sodium ferrocyanide absorber at 80 and 300°K and then analyzed. The % change in transmission is plotted vs. velocity for the ferrocyanide absorber at 80°K and for a soft iron absorber at 300°K for comparison. It is concluded that the inner magnetic field in ferrocyanide is less than 10% of that in soft iron. The peaks for ferrocyanide at 300°K fall in the same places as those at 80°K but with amplitudes reduced by $60 \pm 10\%$. It is calculated that a ferrocyanide source at room temperature will emit about 40% of the 14.4-keV gamma ray without energy change as compared with 60% for soft iron. (D.L.C.)

15329

RESULTS ON THE CROSS SECTION FOR THE REACTION $p + D \rightarrow \text{He}^3 + \pi^0$ AT 600 MEV. Massimiliano Ferro-Luzzi and Guido Pizzella (Università Rome and Istituto Nazionale di Fisica Nucleare, Rome). Ricerca sci. **30**, 400-404(1960) Mar. (In Italian)

The $p + D \rightarrow \text{He}^3 + \pi^0$ reaction at 600 Mev was studied with nuclear emulsions. The cross section was measured at various angles. (tr-auth)

15330

THE DEFORMATION OF LIGHT NUCLEI. Min Yü, Chia-hsien Teng, Hsiao-tsen Chou, and Yank-kou Lee (Inst. of Atomic Energy Research, Academia Sinica, Peking). Sci. Sinica (Peking) **8**, 935-61(1959) Sept. (In English)

It has been found, from energy spectra analyses, that some light nuclei seem to possess rotational levels. The theory of collective models is applied in a study of ground and excited states and the deformation relations for several nuclei. It has been found that the effect of pairing energy on nuclear deformation is small, while the rotational perturbation effect is great. In certain cases, O^{17} and O^{18} , the latter is great enough to change the shape of a nucleus from a prolate spheroid to a sphere and alter the order of levels corresponding to definite configurations. (B.O.G.)

15331

CALCULATION OF RADIAL INTEGRALS, APPEARING IN ATOMIC SPECTRUM THEORY. V. V. Vanagas, K. K. Ushpalis, and I. I. Glemobotskiy (Inst. of Physics and Mathematics, Academy of Sciences, Lithuanian SSR). Trudy Akad. Nauk Litovskoy S.S.R., Ser. B No. 1, 31-40 (1960). (In Russian)

Double radial integrals appearing in quantum nuclear

theory are expressed by the sum of integrals of identical appearance. General properties of these integrals are investigated and formulas are derived for the case of analytical radial wave functions. Tabulating processes for these functions are discussed. (R.V.J.)

15332

THEORETICAL ANALYSIS OF FINE NUCLEAR STRUCTURE N I AND O II IN $1s^2 2s^2 p^2 nl$ CONFIGURATION.

R. S. Dagis (Dagys) and Ya. I. Vizbaraite. Trudy Akad. Nauk Litovskoi S.S.R., Ser. B, No. 1, 71-85(1960). (In Russian)

The formula is derived for the spin interaction matrix element for three nonsaturated shells and adapted to the case where one shell is locked. Formulas are also derived for spin interaction diagonal matrix elements for configurations $s^2 p^2 l$, where $l = s, p, d$, and f . The results are presented of fine structure LS bonds for configurations $2p^2 3s$, $2p^2 3p$ OII, and $2p^2 3d$, $2p^2 4$ NI and OII. Theoretical and experimental data are correlated. (R.V.J.)

15333

THE EFFECTIVE CROSS SECTIONS OF SOME NUCLEAR REACTIONS CAUSED BY 14-Mev NEUTRONS IN THE SCINTILLATION CRYSTALS NaI(Tl), KI(Tl), CsI(Tl), AND $Li^6 I(Eu)$. M. Bormann, H. Jeremie, G. Andersson-Lindström, H. Neuert, and H. Pollehn (I. Institut für Experimentalphysik, Hamburg). Z. Naturforsch., 15a, 200-10(1960) Mar. (In German)

In the study of reactions which are released in the detector crystals themselves, one has the advantage of the relative high detection probability. Therefore, one can both detect a radioactivity released in the crystal by collision with neutrons and also measure the energy distribution of particle reactions. By activation the following cross sections were determined: $\sigma_{np}(I^{127}) = 25 \pm 15$ mb; $\sigma_{np}(Na^{23}) = 9 \pm 4$ mb; $\sigma_{na}(Na^{23}) = 29 \pm 9$ mb; and $\sigma_{na}(K^{41}) = 12 \pm 5$ mb. If the processes caused by the tritium neutron are counted in coincidence with the α particles of the $D(T, \alpha)n$ reactions, then the absolute cross sections can also be measured, that is, the total cross sections of all reactions occurring in the crystal. The method for simultaneous determination of the pulse rise time permits also the distinction of pulses which are caused by α particles, protons, or electrons. Therefore, the following total cross sections were determined: $\sigma_{np}(Cs^{133} + I^{127}) = 34 \pm 5$ mb; $\sigma_{p,np}(Cs^{133} + I^{127}) = 6 \pm 1$ mb; $\sigma_{np}(K^{39}) = 354 \pm 54$ mb; $\sigma_{na}(K^{39}) = 110 \pm 16$ mb; and $\sigma_{p,np}(K^{39}) = 186 \pm 28$ mb. From the proton energy distributions the nuclear temperature for the (n, p) and (n, np) processes can be determined by use of the statistical theory. (tr-auth)

15334

MEASUREMENT OF THE CAPTURE GAMMA AND X-RAY SPECTRA OF Sm AND Gd. John T. Wasson (Technische Hochschule, Munich). Z. Naturforsch., 15a, 276(1960) Mar. (In German)

The energies of the γ and x radiation which Sm and Gd emit in neutron capture were measured between 20 and 450 kev. The elements investigated were natural isotopic mixtures of the oxides with a purity of 99.9%. The results are tabulated and compared with previous results. (J.S.R.)

15335

THE DECAY OF Ta^{182} . H. Daniel (Max-Planck-Institut für Kernphysik, Heidelberg, Ger.). Z. Naturforsch., 15a, 284-5(1960) Mar. (In German)

Ta^{182} decays with β^- emission directly to the 1.222 (2+), 1.290 (2-), 1.554 (4-), and probably also 1.374 (3-)

Mev levels of W^{182} . It was the aim of the present work to determine an upper intensity range, especially for the transition to the 2+ level at 0.100 Mev. The measurements gave an upper range of 0.5% per decay for a possible β transition to the 0.100-Mev level and 0.2% per decay for a transition to the ground state. The corresponding lower range of the log ft is 12.1 or 12.6. The significance of these results is discussed. (J.S.R.)

15336

INVESTIGATION OF THE DECAY Bi^{212} (ThC) β

Po^{212} (ThC') α Pb^{208} (ThD) BY (γ, α) COINCIDENCES. Ulrich Hauser and Werner Kerler (Universität, Heidelberg, Ger.). Z. Physik 158, 405-16(1960) Apr. (In German)

The γ spectrum of Po^{212} (ThC') was measured by (γ, α) coincidences with a fast-slow coincidence apparatus. The results are in excellent agreement with the conversion lines found by the Latyshev group. The absolute γ intensities were also determined in order to get spins and parities of the levels by calculating the absolute conversion coefficients. The β intensity leading to the excited states of Po^{212} (ThC') is estimated to be about one third of that measured by Burde and Rozner by (β, α) coincidences. Three γ lines measured by Chinaglia and Demichelis by (γ, α) coincidences do not agree with these results. The 2^+ assignment of the first excited state is now well established, but for the other levels in the decay scheme there is still some uncertainty concerning spin and level assignment. (auth)

15337

MEASUREMENT WITH A CRYSTAL SPECTROMETER OF SOME SOFT GAMMA LINES IN THE NEUTRON CAPTURE IN EUROPIUM. Otto Schult (Technische Hochschule, Munich). Z. Physik 158, 444-70(1960) Apr. (In German)

15338

MEASUREMENT OF THE SPECTRA AND AVERAGE NUMBER OF NEUTRONS EMITTED IN THE FISSION OF U^{235} AND U^{238} INDUCED BY 14.3 MEV NEUTRONS. Yu. A. Vasil'ev, Yu. S. Zamyatnin, Yu. I. Il'in, E. I. Sirotinin, P. V. Toropov, and E. F. Fomushkin. Zhur. Eksptl'. i Teoret. Fiz. 38, 671-84(1960) Mar. (In Russian)

The fission neutron spectra and average number of neutrons $\bar{\nu}$ emitted in the fission of U^{235} and U^{238} induced by 14.3 Mev neutrons were measured. The measurements were performed at energies between 0.4 and 5 Mev by the time of flight technique in which a pulsed neutron source was used. The spectra obtained are interpreted as consisting of the distribution of neutrons emitted by the fragments and the distribution of neutrons evaporated prior to fission of the nucleus. The following distribution parameters were determined: $T_f = (1.06 \pm 0.03)$ Mev, $T = (0.37 \pm 0.04)$ Mev and fraction of evaporated neutrons $\alpha = (16 \pm 2)\%$ for U^{235} and $T_f = (1.16 \pm 0.03)$ Mev, $T = (0.4 \pm 0.04)$ Mev, $\alpha = (21 \pm 2)\%$ for U^{238} . The measured values of $\bar{\nu}$ were 4.17 ± 0.30 for U^{235} and 4.28 ± 0.30 for U^{238} , their ratio being $\bar{\nu}(U^{238})/\bar{\nu}(U^{235}) = 1.03 \pm 0.03$. (auth)

15339

INVESTIGATION OF THE INTERACTION BETWEEN AN ELECTRON BEAM AND PLASMA. I. F. Kharchenko, Ya. B. Faynberg, R. M. Nikolaev, E. A. Kornilov, E. A. Lutsenko, and N. S. Pedenko. Zhur. Eksptl'. i Teoret. Fiz. 38, 685-92(1960) Mar. (In Russian)

Results of an experimental investigation of the interaction between a modulated and unmodulated beam of high energy electrons and the high frequency discharge plasma are presented. It is shown that when the unmodulated beam moves through the plasma, oscillations arise in the beam which possess a frequency close to that of the plasma. The dependence of the oscillation amplitude on the fre-

quency and parameters of the plasma was determined. Coherent energy losses of electrons in a modulated and unmodulated beam passing through the plasma were investigated. (auth)

15340

INELASTIC SCATTERING OF PROTONS AND DEUTERONS BY Mg^{24} . O. F. Nemets and G. A. Prokopets. Zhur. Eksptl'. i Teoret. Fiz. **38**, 693-6(1960) Mar. (In Russian)

The angular distribution of 6.8 Mev protons and 13.6 Mev deuterons inelastically scattered by Mg^{24} , in which the 2^+ , 1.37 Mev level was excited, was investigated at angles from 2.5 to 140° . Some hitherto unknown details of the angular distribution in the small angle region were detected. Comparison with inelastic scattering theories shows that the direct interaction mechanism is important. (auth)

15341

ANOMALOUS DECAYS OF HYPERFRAGMENTS. S. A. Azimov, U. G. Guliyamov, R. Karimova, and B. G. Rakhimbaev. Zhur. Eksptl'. i Teoret. Fiz. **38**, 697-702(1960) Mar. (In Russian)

Two events of K-meson decay of hyperfragments are described. They are compared with previous hyperfragment decay events and some common features are noted. It is shown that the events cannot be explained by statistical deviations of the characteristics of the particle tracks in the emulsion. (auth)

15342

INTERACTION BETWEEN 630 Mev PROTONS AND He^4 NUCLEI. M. S. Kozodaev, M. M. Kulyukin, R. M. Sulyaev, A. I. Filippov, and Yu. A. Shcherbakov. Zhur. Eksptl'. i Teoret. Fiz. **38**, 708-15(1960) Mar. (In Russian)

A high pressure diffusion cloud chamber was employed to study scattering of 630 Mev protons on helium nuclei. The total, elastic, and inelastic cross sections were measured and found to equal respectively $(150 \pm 13) \times 10^{-27} \text{ cm}^2$, $(24 \pm 5) \times 10^{-27} \text{ cm}^2$, and $(126 \pm 14) \times 10^{-27} \text{ cm}^2$. The angular distribution for elastic scattering can be satisfactorily described by the optical model with a complex potential with $V_R = 30$ Mev, $V_I = -(34 \pm 4)$, and $R = 1.45 \cdot 10^{-13} \text{ cm}$. Quasielastic proton—proton scattering and quasi-free proton—neutron interactions were singled out. The cross sections for these reactions were $(15 \pm 2) \times 10^{-27} \text{ cm}^2$ and $(24 \pm 2) \times 10^{-27} \text{ cm}^2$ per nucleon. It is demonstrated that in 20% of the events a cascade develops or the primary particle experiences a collision with a group of nucleons. Events involving π^- -meson creation in pn -collisions were treated separately and it was established that the cross section for this process is $(1.3 \pm 0.5) \times 10^{-27} \text{ cm}^2$ per neutron. (auth)

15343

FISSION OF URANIUM NUCLEI INDUCED BY 9 Bev PROTONS. N. A. Perfilov, V. F. Darovskikh, G. F. Denisenko, and A. I. Obukhov. Zhur. Eksptl'. i Teoret. Fiz. **38**, 716-18(1960) Mar. (In Russian)

Characteristics of uranium fission produced by 9 Bev protons are obtained which include the magnitude of the cross section, dependence of yield on ratio of fragment ranges, data on number of light charged particles involved in fission, and the angular distributions of the fragments. (auth)

15344

ON RELATIVE γ -TRANSITION PROBABILITIES IN STRONGLY DEFORMED NUCLEI. A. V. Gnedich, L. N. Kryukova, and V. V. Murav'ev. Zhur. Eksptl'. i Teoret. Fiz. **38**, 726-8(1960) Mar. (In Russian)

The relative intensities of the γ -transitions in Lu^{175} and Hf^{177} were determined from the photoelectron spectra. The discrepancy between the experimental values for the relative γ -transition probabilities and the theoretical values derived by Alaga rules was confirmed. A similar discrepancy between the experimental and theoretical values was also found to hold for the Yb^{173} and W^{183} nuclei. (auth)

15345

EXCITED STATES OF Cs^{134} . A. S. Melioranskii, I. V. Zstulin, L. F. Kalinkin, and B. S. Kudinov. Zhur. Eksptl'. i Teoret. Fiz. **38**, 758-64(1960) Mar. (In Russian)

Cascade γ -transitions induced in cesium nuclei by thermal neutron capture were studied. The scheme of low energy Cs^{134} levels of excitation energies up to 320 kev is discussed. (auth)

15346

INVESTIGATION OF THE γ -SPECTRUM OF Ce^{140} . S. F. Antonova, S. S. Vasilenko, M. G. Kaganskii, and D. L. Kaminskii. Zhur. Eksptl'. i Teoret. Fiz. **38**, 765-7(1960) Mar. (In Russian)

Gamma radiation with energy above $2mc^2$ from Ce^{140} was investigated. For this purpose the internal pair conversion positron spectrum of decaying La^{140} was measured. By comparison of this spectrum with the corresponding K shell electron conversion lines the multipolarities and intensities of γ -quanta with energies $E_\gamma = 1596, 2330$, and 2525 kev were determined. It is shown that for transitions involving energies above $2mc^2$ such a method of determination of γ -quantum characteristics is advantageous in certain respects. (auth)

15347

NUCLEON EMISSION BY A ROTATING NUCLEUS. G. A. Pick-Pichak. Zhur. Eksptl'. i Teoret. Fiz. **38**, 768-72(1960) Mar. (In Russian)

The effect of a large angular momentum on nucleon emission by an excited nucleus is determined in the independent-particle model. The mean characteristics of neutron emission as a function of temperature and angular momentum are calculated. An estimation is made of the mean excitation energy which remains after emission of the nucleons and which is carried off by the γ -quanta. (auth)

15348

PHOTOPROTONS FROM Cu^{65} . N. V. Lin'kova, R. M. Osokina, B. S. Ratner, R. Sh. Amirov, and V. V. Akindinov. Zhur. Eksptl'. i Teoret. Fiz. **38**, 780-9(1960) Mar. (In Russian)

The energy and angular distributions of photoprotons produced in a Cu^{65} enriched sample by bremsstrahlung with peak energies $E_{\gamma \text{ max}} = 17.9, \sim 20, 24.5$, and 28.5 Mev were studied with photographic emulsions. The dependence of the Cu^{65} photoproton yield on $E_{\gamma \text{ max}}$ was measured and the excitation curve for reactions involving the emission of a proton was determined. An analysis of the experimental data shows that a greater part of the proton yield is due to a mechanism which differs from that of evaporation. If this mechanism is assumed to be a direct photoeffect in which all the γ -quantum energy minus the binding energy is imparted to the ejected proton, one finds from the energy distributions that only a small part of the protons is due to a photoeffect from the upper level, the main contribution being due to transitions from lower shells. Two maxima at proton energies of $E_p \approx 4.7$ Mev and 6.0 Mev are observed in the emitted particle spectrum. (auth)

15349

HIGH ENERGY PHOTONUCLEAR DEUTERONS AND

TRITONS. V. P. Chizhov. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 809-18(1960) Mar. (In Russian)

The ratio of the (γ, d) cross sections to the (γ, p) cross sections for 15.5 to 30 Mev protons and deuterons produced by $E_{\gamma \max} = 90$ Mev bremsstrahlung is presented as a function of the nuclear mass number A for fourteen elements lying between Li^6 and Au. For intermediate and heavy nuclei $\sigma(\gamma, d)/\sigma(\gamma, p) \sim A^{3/2}/Z$ which corresponds to the concept of capture photodeuteron production. The energy dependences of $\sigma(\gamma, d)/\sigma(\gamma, p)$ for Li^6 and Li^7 and also the energy distributions of photodeuterons from Li^6 and Li^7 and of phototritons from Li^7 are presented. A relatively large yield of high energy phototritons from Li^6 , Li^7 , and B was observed. The angular distributions of photoprotons and photodeuterons from Li^6 , Li^7 , Be, and C are compared. The shape of the experimental photodeuteron angular distributions is found to agree with those computed on the assumption that the photodeuterons are produced as a result of capture. Angular distributions of high energy phototritons from Li^6 , Li^7 , and Be are also presented. (auth)

15350

ELECTROMAGNETIC WAVES IN A MEDIUM WITH A CONTINUOUS ENERGY SPECTRUM. [PART] I. V. S. Mashkevich. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 906-11 (1960) Mar. (In Russian)

The dependence of the polarization vector on the electric field strength is established for a medium possessing a continuous energy spectrum. An integral expression defining the polarizability is derived. Dispersion relations between the Hermitian and non-Hermitian parts of the nucleus are deduced. (auth)

15351

ON THE STRUCTURE OF THE Be^9 NUCLEUS. I. Sh. Vashakidze, T. I. Kopaleishvili, V. I. Mamasakhlisov, and G. A. Chilashvili. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 937-41 (1960) Mar. (In Russian)

For the Be^9 nucleus viewed as consisting of two α -particles and a neutron the equilibrium distances between the α -particles and between the neutron and centers of the α -particles were determined from the condition of minimum energy. Vibrations along the symmetry axis and about the center of mass of the α -particles were considered and the energy levels of the Be^9 nucleus were derived. The results obtained are compared with data relating to the ΛBe^9 hypernucleus. (auth)

15352

ORIENTATION OF NUCLEI DURING SATURATION OF FORBIDDEN RESONANCE AND DOUBLE RESONANCE. G. R. Khutsishvili. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 942-7(1960) Mar. (In Russian)

The parameters f_k characterizing the degree of orientation of nuclei are computed in the case of forbidden resonance and double resonance. Modifications of the double resonance method are examined. (auth)

15353

THE INTERNAL BREMSSTRAHLUNG IN β -DECAY OF POLARIZED NUCLEI. Ch'eng-jui Ch'ing and F. Janoukh. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 948-51(1960) Mar. (In Russian)

The internal bremsstrahlung in β -decay of polarized nuclei is considered. The general form of angular distributions is given. It is shown that the measurement of the correlation between the direction of emission of internal bremsstrahlung quanta and the direction of polarization of nuclei provides information on the form of β -interaction. (auth)

15354

ON EXCITATION OF FISSION FRAGMENTS AND THEIR DISTRIBUTION IN MASS. B. T. Geilikman. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 955-8(1960) Mar. (In Russian)

The influence of shell effects for elastic constants and mass coefficients of vibrational degrees of freedom of a nucleus on the mass distribution of fission fragments and on the magnitude of their excitation energy is considered. (auth)

15355

NUCLEAR SPECTROSCOPY. PART B. Fay Ajzenberg-Selove, ed. Pure and Applied Physics. A Series of Monographs and Textbooks. Volume 9. New York, Academic Press, 1960. p.625-1147. \$16.00.

A theoretical analysis of nuclear spectroscopy data on the compound nucleus, direct interactions, internal conversions, reduced widths, isotopic spin selection rules, and beta and gamma decay is presented. Nuclear models are discussed relative to the nuclear shell and complex potential models, nuclear coupling schemes, collective motion, and nuclear spectra. (C.J.G.)

Particle Accelerators

15356 AERE-PLAC-9

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

MANUFACTURING, MEASUREMENT AND OPERATING TEMPERATURES AND FREQUENCIES FOR THE PROTON LINEAR ACCELERATOR. B. G. Leach. Apr. 1955. 12p.

The effects of temperature change and of evacuated and air filled conditions are examined in detail in relation to the manufacture, setting up, cooling, and operating of tanks of the proton linear accelerator. It is shown that the procedure may be greatly simplified due to the tendency for self cancellation of opposing effects. (auth)

15357 CERN-60-15

European Organization for Nuclear Research, Geneva. THE MAGNETIC GUIDE FIELD AND THE ORBITAL EQUATIONS FOR A FIXED FIELD TWO-WAY SCALING ACCELERATOR. Nils Vogt-Nilsen. Mar. 29, 1960. 87p.

Expressions are presented for suitably chosen guide fields and the general differential equations of motion for charged particles moving in these fields. All equations are given in a form which is considered most suitable for rapid numerical calculation on a digital computer with a relatively small fast working store capacity. Any coupling between the betatron and synchrotron oscillations is disregarded. Interactions between the charged particles and the residual gas are also disregarded. (W.D.M.)

15358 DESY-A2.60

Deutsches Elektronen-Synchrotron, Hamburg. STRAHLENBELASTUNG DER VAKUUMKAMMER-WAND. (Radiation Dose to Vacuum-Chamber Wall). G. Bathow. Apr. 8, 1960. 13p.

The radiation dose received by the walls of the electron synchrotron is calculated. (T.R.H.)

15359 NP-8623

Illinois. Univ., Urbana. A VARIABLE ENERGY SPIRAL RIDGE CYCLOTRON. James S. Allen, Santimay Chatterjee, Loren E. Ernest, and Avivi I. Yavin. 1959. 40p.

A spiral ridge cyclotron which can accelerate protons from 3.5 to 15 Mev, deuterons from 7 to 14 Mev, He^{3+4} from 11 to 37 Mev, and alpha particles from 15 to 27 Mev is described. The required magnetic field is obtained from

four spiral shims and five correction coils placed on each of the pole faces of the magnet. The spiral shims produce a maximum rms flutter of 0.07 which provides sufficient vertical focusing beyond a radial distance 6 in. from the center of the cyclotron. The two innermost correction coils provide magnetic focusing up to 6 in. and the three outer coils build up the isochronous field. Focusing effects of slits, placed on the dee and the dummy dee in the path of the particles for the first four revolutions, are demonstrated. The machine can deliver 1 ma of proton beam at the extraction radius 18.5 in. (auth)

15360 TID-5767

Minnesota. Univ., Minneapolis. Linear Accelerator Lab. ANNUAL PROGRESS REPORT FOR PERIOD DECEMBER 1958 THROUGH NOVEMBER 1959. 130p. Contract AT(11-1)-50. OTS.

The results of experimental and theoretical research performed during the past year are presented. The performance of the accelerator is discussed, along with improvements and new techniques used to increase its usefulness. The experimental program comprising proton-proton scattering, proton-nucleus elastic scattering, and proton-nucleus reactions is reported. Work in the theoretical program is summarized under the areas of quantum field theory, many-body problem, and nuclear physics and reaction theory. Instrumentation discussed includes the magnetic spectrometer, polarized proton source, scattering chamber, low pressure gage, electron beam light pulser, differential beam collector, pulse gates, transistorized preamps, voltage discriminator, curve tracer, and bridge for measuring transistor cutoff frequencies. (See also AECU-3707.) (W.D.M.)

15361 TID-5784

Midwestern Universities Research Assn., [Madison, Wis.] QUARTERLY REPORT OF THE LABORATORY DIRECTOR FOR THE PERIOD JANUARY 1, 1960 TO MARCH 31, 1960. 5p. OTS.

Research activities at MURA on the Two-way model large accelerator design, linac design, r.f. acceleration, beam trapping, and hydrogen bubble chambers are briefly summarized. (See also AECU-4446.) (W.D.M.)

15362

APPARATUS FOR THE MEASUREMENT OF THE INTENSITY DISTRIBUTION OF THE IONIC CURRENT ON A TARGET IN THE REACTION CHAMBER OF A CYCLOTRON. A. Grigoriu, M. Macovei, C. Popescu, and T. Toth. *Acad. rep. populare Romîne, Inst. fiz. atomică și Inst. fiz. Studii cercetări fiz.* 10, 473-80(1960). (In Rumanian)

A new apparatus for the measurement of the intensity distribution of the ion beam produced by a cyclotron is described. Its operational principal consists of exploring transversely the ion beam with a rotating disk with de-phased openings and of recording with an oscilloscope the instantaneous value of the ion current reaching a target placed behind the disk. The image produced by the oscilloscope represents the distribution of the intensity of the beam in the direction of the movement of the openings and the length of the radius of the trajectory of the openings. The apparatus can be utilized for control during the operation of the cyclotron. It has the advantage of being able to operate with high beam intensities, of being easy to manipulate, and of allowing the direct reading of the oscilloscope recordings. (tr-auth)

15363

PERFORMANCE OF A LINEAR ACCELERATOR IN CLINICAL SERVICE. David Greene and K. A. Nelson

(Christie Hospital, Manchester, Eng. and Holt Radium Inst., Manchester, Eng.). *Brit. J. Radiol.* 33, 336-8 (1960) May.

The performance of a 4-Mv linear accelerator in routine clinical service is evaluated after 5 years' service. Routine maintenance procedures are also discussed. (C.H.)

15364

EQUIPMENT FOR THE EXPERIMENTAL EXPLOITATION OF THE LINEAR ACCELERATOR. M. G. R. Bishop (*École Normale Supérieure, Orsay, France*). *J. phys. radium* 21, 21S-24S(1960) Feb. (In French)

The 250-Mev experimental control room of the Orsay linear accelerator is completely equipped. The principal apparatus is a double-focusing magnetic spectrometer for charged particles with a maximum velocity of 300 Mev/c. This spectrometer is described in some detail. The 500-Mev experimental control room will be equipped with a triple-focusing spectrometer. The experimental program planned for the Orsay linear accelerator is described. (J.S.R.)

15365

FINAL IMPLEMENTATION AND RESULTS OF THE MEASUREMENT OF A HIGH FREQUENCY ION SOURCE IN A VAN DE GRAAFF ACCELERATOR. E. Cilensek, F. Cvelbar, and V. Ramsak. "*J. Stefan*" *Inst. Repts. (Ljubljana)* 4, 117-22(1957). (Translated from *Referat. Zhur. Fiz.* No. 9, 1959. Abstract No. 20679).

By washing the discharge tube with a 5% solution of hydrofluoric acid the fraction of the protons in the ion gun increased from 32 to 48%. Reduction in the area of the metallic surfaces and washing the tube with 10% solution of hydrofluoric acid made it possible to increase the proton component to 76%. Under the optimum conditions, a current of 118 μ a (85%) H_1^+ , 17 μ a (12%) H_2^+ , and 4 μ a (3%) H_3^+ was obtained in the collector. Measurements showed that if undried H_2 was used, the composition of the ion gun deteriorates noticeably. The results of measurements and mass analysis of the ion current are given for a permanent optimum condition, the ion current obtained was 120 μ a (91%) for H_1^+ , 11 μ a (8%) for H_2^+ , and 1 μ a (1%) for H_3^+ .

15366

AN ELECTRON ACCELERATOR IN PRESSURIZED TANK FOR 3 mA AT 1.5 MV DIRECT VOLTAGE. G. Henneberke (N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). *Nuclear Instr. & Methods* 7, 89-98(1960) Apr. (In English)

A 14-stage accelerating tube is supplied by a 7-stage Cockcroft-Walton generator with selenium rectifying units. The potential distribution across the accelerating tube is ensured by a parallel resistor. Special care was devoted to the electron-optical part and this makes it possible to control a 3 ma electron beam with a current of 110 μ a through the parallel resistor at a generator load of 3.2 ma. Focussing and intensity of the beam are independent of the high tension. X-ray intensities of 300 r/min at a distance of one meter from the target are readily attainable. (auth)

15367

NEGATIVE ION SOURCE. (to High Voltage Engineering Corp.). British Patent 833,658. Apr. 27, 1960.

A negative ion source is described for use with accelerators. Positive ions are accelerated to 10^4 v and passed through an electron pickup capillary into which the electron donating gas is fed from the side. Negative ions emitted from this tube are further accelerated while secondary electrons are suppressed. The dimensions and materials used are given. (T.R.H.)

15368

PARTICLE ACCELERATION. (to High Voltage Engineering Corp.). British Patent 833,659. Apr. 27, 1960.

An arrangement of an accelerator for Bev proton experiments is described. Both a positive and negative beam are accelerated in a single proton synchrotron, but in opposite directions. They can be made to collide, then, at some target area. (T.R.H.)

15369

IMPROVEMENTS IN INTERNAL MAGNETIC DEFLECTION SYSTEM FOR ELECTRON BEAM GENERATOR. (to General Electric Co.). British Patent 834,996. May 18, 1960.

A longitudinal magnetic deflection system is described which is used inside an electron beam generator to reduce window heating. The system has two serially connected opposed conductors mounted in an extension chamber on opposite sides of and parallel to the axis of the chamber. The conductors are hollow for cooling. In one example a longitudinal deflection frequency of 100,000 cps is used with conductors 50.8 cm long and a reactance of 0.114 ohms. This oscillator is coupled through a matching transformer to conductors mounted in the extension chamber neck. Thus the beam is spread evenly over the window with less heating and damage. (T.R.H.)

Plasma Physics and Thermonuclear Processes

15370 60GL63

General Electric Co. General Engineering Lab., Schenectady, N. Y.

M. H. D. DIAGNOSTICS—GAS TEMPERATURE AND EMITTANCE. W. E. Hill. Apr. 6, 1960. 17p.

Gas temperature and emittance are examples of significant parameters that are common to both combustion and anticipated M. H. D. instrumentation. Such developed radiation techniques for temperature measurement as line reversal, two path, two color, and population method are reviewed. The Schmidt method for determining gas emittance is discussed and specific results are included. (auth)

15371 AERE-R-3135

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

EQUILIBRIUM CONFIGURATIONS OF A TOROIDAL GAS DISCHARGE. 2. CONFIGURATIONS WITH ALMOST SEPARATED FIELDS. K. J. Whiteman. Dec. 1959. 30p. BIS.

A perturbation method is derived for generating toroidal equilibria from cylindrically symmetric configurations. A program was written for the mercury computer and is available for calculating such toroidal fields to second order in the expansion parameter. Two examples are given that correspond to equilibrium in a torus of aspect ratio 6 and a pinch ratio of 2. (For Part I see AERE-R-2895.) (W.D.M.)

15372 AFOSR-TN-60-287

California Inst. of Tech., Pasadena. Guggenheim Jet Propulsion Center.

ELECTRODE BOUNDARY LAYERS IN DIRECT CURRENT PLASMA ACCELERATORS. Technical Note No. 1. Jack L. Kerrebrock. Jan. 1960. 52p. Contract AF49(638)-758. OTS.

One of the problems in the development of d-c plasma

accelerators is that of boundary layer growth on the electrode surfaces. These surfaces must be maintained at a somewhat lower temperature than is desirable in the bulk of the gas flow. The associated reduction in electrical conductivity near the electrode surface, together with the continuous current through the boundary layer, may result in greatly augmented Joule heating near the surface, and increased heat transfer. This phenomenon is treated within the framework of boundary layer theory. It is found that similar solutions for the thermal and viscous boundary layers exist for a certain class of accelerated flows in which the velocity varies as a power of the streamwise coordinate. The solutions show that the heat transfer rate at Mach numbers near unity may be as much as ten times that which would be expected for a normal boundary layer. At higher Mach numbers, the similarity is not precisely valid; however, the analysis indicates qualitatively that a stagnation enthalpy overshoot may occur in the high temperature portion of the boundary layer as a result of the electromagnetic acceleration. (auth)

15373 AFOSR-TN-60-367

Avco Corp. Avco-Everett Research Lab., Everett, Mass. **SCALING RELATIONS FOR PLASMA DEVICES.** Research Report No. 80. G. S. Janes. Dec. 1959. 13p. Contract AF49(638)-659.

The derivation of a set of scaling relations for plasma devices in which the dominant interparticle interactions occur as a result of coulomb collisions is presented. These scaling relations have application in the avoidance of redundant experimentation and in the design of laboratory scale experiments to simulate the principal conditions of interest to an engineering objective. Charge neutrality is assumed while displacement currents, radiation, and phenomena (such as plasma oscillations) which involve energy storage in an electrostatic field are neglected. On the basis of the remaining physical laws, a determinate set of rules which yield explicitly the properties of all similar systems is obtained. (auth)

15374 AFOSR-TN-60-405

Air Force Office of Scientific Research, Washington, D. C. and Republic Aviation Corp., Farmingdale, N. Y. **AFOSR THIRD CONTRACTORS' MEETING ON ION AND PLASMA PROPULSION, MARCH 22-24, 1960.** 50p.

Abstracts are given for the papers presented at the Third AFOSR Contractors' Meeting on Ion and Plasma Propulsion. The conference was held at Farmingdale, N. Y., on March 22-24, 1960. (W.D.M.)

15375 ARC-21106

Liverpool. Univ.

SOME TWO DIMENSIONAL PROBLEMS IN MAGNETO-HYDRODYNAMIC FLOWS AT LOW MAGNETIC REYNOLDS NUMBER. J. H. Horlock. June 23, 1959. 19p. (Hyp-34).

A study is made of some two-dimensional flows of an incompressible inviscid, uniformly conducting fluid in the presence of applied magnetic fields, for the case in which the magnetic Reynolds number (the ratio of induced fields to applied fields) is low but the magnetic force coefficient (the ratio of electromagnetic force to inertia force) may be high. A variety of velocity perturbations of a uniform flow are considered, including the flow through a magnetic nozzle. All these perturbations are strongly dependent upon the magnitude of the magnetic force coefficient. (auth)

15376 JPL-TR-32-3

California Inst. of Tech., Pasadena. Jet Propulsion Lab. **ON THE ROLE OF VISCOSITY AND CONDUCTIVITY IN**

MAGNETOHYDRODYNAMICS. Meredith C. Gourline.

Jan. 7, 1960. 29p. Contract NASw-6.

Oseen's techniques are used to linearize and find two-dimensional fundamental solutions for magnetohydrodynamic flow over solid bodies. The fluid is assumed to be incompressible, with finite viscosity and conductivity. The solutions for the limiting cases of zero viscosity and infinite conductivity are compared with the work of Lary and of Hasimoto; there is essential agreement. The assumption of zero viscosity is valid if $\sigma\mu\nu \ll 1$, and the assumption of infinite conductivity is valid if $\sigma\mu\nu \gg 1$. (σ is the conductivity; μ is the permeability; and ν is the kinematic viscosity of the fluid.) Two wakes are found: the first wake is always downstream; the second wake is downstream if $\alpha < 1$, and upstream if $\alpha > 1$, where α is the Alfvén number. The first wake vanishes in the limit of zero viscosity or infinite conductivity. (auth)

15377 MH-5

New York Univ., New York. Inst. of Mathematical Sciences.

RESOLUTION OF AN INITIAL SHEAR FLOW DISCONTINUITY IN ONE-DIMENSIONAL-HYDROMAGNETIC FLOW.

Jack Bazer. June 1956. 125p. Contract AF19(604)-926. (AFCRC-TN-56-656; AD-98712).

The nonlinear one-dimensional hydromagnetic flow problem of the resolution of an initial shear flow discontinuity in a perfectly conducting, electrically neutral, compressible fluid is treated. Switch-on shocks, fast gas shocks, and slow simple wave solutions are investigated in detail. The exact nature of the dependence of pressure ratios and other quantities of interest on the parameters which characterize the state in front of the advancing shocks is obtained by a combination of graphical and numerical methods. (W.D.M.)

15378 NP-8646

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

STX—A PROPOSED THERMONUCLEAR DEVICE.

Richard W. Hales. Apr. 15, 1960. 16p. Contract AF04 (647)-309. (STL/TR-60-0000-09085).

A design study is presented for a thermonuclear device, STX, in which the features of the linear and transverse pinches would be combined. The name derives from the use of two magnetic fields for containment which are crossed in space and time—that is, orthogonal in space (B_0 and B_z) and in time quadrature. (auth)

15379 P-1827(RAND)

RAND Corp., Santa Monica, Calif.

ON ONE-DIMENSIONAL INVISCID MAGNETOHYDRODYNAMIC FLOW. J. D. Cole and J. H. Huth. Oct. 15, 1959.

Revised Dec. 28, 1959. 19p.

The one-dimensional steady flow of a compressible inviscid conducting gas through a transverse magnetic field is characterized by a single non-dimensional plot, independent of conductivity. The coordinates are the magnetic field strength and the fluid flow velocity; parameters which characterize events are the entrance Mach number, constant electric field, and the ratio of magnetic energy density to initial flow kinetic-energy density (the magnetic pressure number). Based on this diagram, it is shown that the maximum fraction of the initial stream specific total enthalpy which may be extracted from a channel of constant cross-section is $3/7$ (with a ratio of specific heats of $4/3$). (auth)

15380 TID-5825

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

PLASMA TURBULENCE. Leslie S. G. Kovaszny.

Feb. 17, 1960. 23p. Contract AT(04-3)-321; STL/TR-60-0000-AE038). OTS.

Recent experimental evidence obtained in high-energy electrical discharges strongly supports the existence of plasma turbulence. An exploratory study was made in which the validity of the simple magnetohydrodynamic equation was assumed and attention was confined to solenoidal turbulent velocity fluctuations. Equations for the mean flow, mean electromagnetic field, and the turbulent energies of the fluctuating fields were obtained. (W.D.M.)

15381 UCRL-5604-T

California. Univ., Livermore. Lawrence Radiation Lab. SOME ASPECTS OF HIGH TEMPERATURE PLASMA RESEARCH WITH THE MIRROR MACHINE. R. F. Post. Jan. 20, 1960. 29p. Contract W-7405-eng-48. OTS.

Paper presented at the IV International Conference on Ionization Phenomena in Gases, Uppsala, Sweden, August 17-22, 1959.

The major effort of the Livermore Mirror Machine group is directed toward study of plasma stability and confinement in mirror geometries. The status and radial density distribution and diffusion of confined plasma are briefly summarized. The ALICE Experiment (Adiabatic Low-energy Injection and Capture Experiment) is discussed in some detail. (W.D.M.)

15382 UCRL-5743-T

California. Univ., Livermore. Lawrence Radiation Lab. INJECTION AND TRAPPING OF HIGH CURRENT ELECTRON BEAMS. N. C. Christofilos. Jan. 25, 1960. 4p. OTS.

An electron injection system for injection and trapping of high current electron beam in the Astron is discussed. The system consists of passive circuits. The electrons are injected at the "top" of the mirror field and then slide "downhill" toward the trapping region. During the "downhill" motion a friction force is provided to absorb the axial momentum gain during their fall into the potential well. Results of the calculations of the slowing down force are briefly summarized. (W.D.M.)

15383 WADC-TR-59-346

General Electric Co. Missile and Space Vehicle Dept., Philadelphia.

PLASMA JET TEMPERATURE STUDY. [Period covered]: June 1958 to June 1959. Willard J. Pearce. July 31, 1959. 111p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: THERMODYNAMICS AND HEAT TRANSFER. Contract AF33(616)-5848. OTS.

Spectral methods for measuring plasma temperatures at 5,000 to 15,000°K were compared on theoretical and experimental grounds. For plasma jets, the best method is to determine the temperature from the intensities of atomic lines or of ionic lines, from the relation $I = K_g A \exp(-E/kT)$. Tables of values of the required constants have been compiled and examples of various modifications of the method are given. Technique and constants are given which permit determination of radial distributions of temperature with the least difficulty. (auth)

15384 WADD-TR-59-486(Pt.II)

Massachusetts Inst. of Tech., Cambridge. Naval Supersonic Lab.

THE EQUATION OF STATE OF AN IONIZED GAS.

PART II. George K. Bienkowski. Sept. 1959. 71p. Project No. 7073. Contract AF33(616)-5693. (MIT-NSL-398). OTS.

Electrically conducting gases, because of the long-range coulombic forces acting between the particles, are not

amenable to the usual treatment of dilute-gas kinetic theory. Calculation of the equilibrium equation of state through the molecular approach must include the forces between particles if it is to correspond to physical reality. In the methods of kinetic theory this implies that potential energy and thus spatial distribution of particles is not negligible. Since it can be shown that the exact equation of state can be computed with the additional knowledge of the distributions of particle-pairs, equilibrium pair distribution functions were investigated. The existing Debye-Huckel approximation as applied to an ionized gas was found to have some limitations as well as theoretical difficulties. The equations which can determine the distribution functions are hopelessly non-linear except for asymptotic regions and therefore approximate solutions are derived for the non-linear range and quantum effects in the ion-electron interactions are included. The resulting distributions are used to calculate the equation of state. The relation thus obtained is found to lie near the Debye-Huckel equation of state but closer to the perfect gas relation. This is a result of the excessive correlation predicted by Debye-Huckel theory because of its neglect of quantum effects. The effect, however, is small for reasonable pressures; thus justifying the use of the Debye-Huckel theory in this region. Higher order effects resulting from the volume of the particles and attractive forces between the charged and neutral particles are evaluated and found to be at least of an order of magnitude smaller than the coulombic effects in the region under consideration. (auth)

15385 ZPh-057

Convoir, San Diego, Calif.

A PLASMA AS A MICROWAVE AMPLIFIER. S. Rand. Mar. 22, 1960. 19p. Contract AF19(604)-5554.

A mechanism is postulated for which a streaming plasma may transmit energy to a traversing radiation field, and thereby enhance the signal. For a laboratory plasma, only resonance frequencies over a narrow band may be amplified significantly by this method. Large amplification over a broad frequency range is postulated for an astronomical gas. (auth)

15386 AFOSR-TN-60-424

Oslo. Universitetet. Institutt for Teoretisk Astrofysikk. ON PLANE STATIONARY SHOCK WAVES IN A PLASMA. Scientific Report No. 3. Kjell Vøyenli. Translated from the Norwegian by Hallvard Rosseland. 1959. 85p. Contract AF61(052)-49.

Equations for plane stationary shocks in a plasma are developed from a general continuum description of a fully ionized plasma consisting of one type of ions and electrons. It is shown that the shock equations are independent of the viscosity and the thermal and electric conductivity of the plasma. The structure of parallel, hydromagnetic and non-magnetic shocks in a hydrogen plasma is discussed. (W.D.M.)

15387

VARIATION OF THE CONSTANTS OF AN OSCILLATING CIRCUIT COUPLED WITH AN IONIZED GAS (H,Ne). Paul Ştubel. Acad. rep. populare Romîne, Inst. fiz. atomică şi Inst. fiz. Studii cercetări fiz. 10, 505-13 (1960). (In Rumanian)

In studying the interaction of a high-frequency field and an ionized gas, it was found that there are two well defined phenomena. The gas absorbs the energy of the high-frequency field. This absorption passes through a maximum in oxygen and hydrogen and has no maximum in neon. This result is explained by admitting that the absorption maximum is caused by negative ions. The

resonance frequency of an oscillating circuit varies as a function of the ionization of the gas, following a characteristic curve. The frequency deviation passes through positive values and becomes negative, the point of passage through zero being the same for the two gases studied. Some considerations on the research necessary to explain this form of the frequency variation are made. (tr-auth)

15388

METHOD FOR THE DETERMINATION OF THE ELECTRON DENSITY OF A PLASMA BY THE GROUP VELOCITY. Terezio Consoli and Dimitri Lepechinski (Centre d'Études nucléaires, Saclay, France). Compt. rend. 250, 2694-6(1960) Apr. 11. (In French)

The variations of the group velocity were studied. It is shown that in the vicinity of its maximum it is very sensitive to the variations of the electron density N_e and that the abscissa of this maximum is itself a function of the value of the magnetic field B . A method for the measurement of N_e was derived. (tr-auth)

15389

METHOD FOR THE SIMULTANEOUS MEASUREMENT OF THE MAGNETIC CONFINEMENT FIELD AND OF THE ELECTRON DENSITY OF A PLASMA. Terezio Consoli and Dimitri Lepechinski (Centre d'Études nucléaires, Saclay, France). Compt. rend. 250, 2813-15(1960) Apr. 20. (In French)

The magnetic rotational polarization in plasma and the passage through a maximum of the group velocity were used to establish a system of two equations between N_e , B , and different known or measurable parameters. This method is applied in the case where the currents circulating in the plasma modify uniformly the value of the magnetic field without altering its direction. (tr-auth)

15390

AN ASYMPTOTIC SOLUTION OF A PROBLEM CONCERNING THE MOTION OF A CONDUCTING PLASMA. G. A. Skuridin and K. P. Stanukovich (Shmidt Inst. of Geophysics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. 130, 1248-51(1960) Feb. 21. (In Russian)

A new method of asymptotic integration of linear differential equations was previously developed and applied in deriving solutions for acoustic and Maxwell equations. The same method was used for resolving dynamic problems in the theory of elasticity. The simplicity of the asymptotic method does not hold for quasi- or non-linear equations; however, formally the method leads to a resolution of a series of problems. The approximation method is applied in integrations of plasma oscillation equations for motion in a medium with finite conductivity. (R.V.J.)

15391

DISPERSION RELATIONS OF PLASMA OSCILLATIONS. I. Kaji and Y. Ozawa (Hokkaido Univ., Japan). J. Atomic Energy Soc. Japan 2, 182-9(1960). (In Japanese)

The possible occurrence of plasma instabilities has increased the necessity of further investigation on plasma oscillations since the Second International Conference in Geneva. Though a number of papers has already been presented, there still remain a number of unsolved problems. Detailed considerations are made on the dispersion equations of potential and velocity distribution functions. Several new dispersion relations are derived and tabulated each for amplified, continuous, and damped plasma oscillations. (auth)

15392

STEADY LONGITUDINAL MOTION OF A CYLINDER IN A

CONDUCTING FLUID. Hidenori Hasimoto (Johns Hopkins Univ., Baltimore). *J. Fluid Mech.* **8**, 61-81(1960) May.

The steady motion of an infinitely long solid cylinder parallel to its length in a conducting fluid in the presence of a uniform magnetic field is discussed. Due to Alfvén waves originating at the cylinder, two opposite 'wakes' appear parallel to the applied magnetic field. A formula which relates the total drag on the cylinder to the electric potential difference $\delta\phi$ between the two undisturbed regions outside these two wakes is derived, $D/[\delta\phi] = 2\sqrt{\rho\nu\sigma}$, where $\rho\nu$ is the viscosity and σ is the conductivity of the fluid. The reduction to a classical boundary-value problem is made for the case of an insulating cylinder. Exact solutions are obtained for the case of a perfectly conducting or an insulating flat strip of semi-infinite width. These give a clear picture of the fields, especially in the transition region near the edge of the strip. The case of a strip of finite width is also discussed with special reference to the viscous and the magnetic drags, D_f and D_m . $D_f + \frac{1}{2}D_m$, on a perfectly conducting strip, is found to be equal to the viscous drag on an insulating strip for which D_m is zero. Precise values of these drags are given. (auth)

15393

ON THE MOTION OF A NON-CONDUCTING BODY THROUGH A PERFECTLY CONDUCTING FLUID. K. Stewartson (Durham Univ., Eng.). *J. Fluid Mech.* **8**, 82-96(1960) May.

The motion of bodies in a direction parallel to an applied magnetic field and through a perfectly conducting fluid is considered. It is shown that the perturbation in the state of the fluid cannot remain small except in the particular case when the velocity U of the body is much smaller than that of the Alfvén waves in the fluid. In this case, however, the perturbation is not confined to the neighborhood of the body, and extends to infinity inside planes which touch the body and are parallel to the undisturbed magnetic field. In addition the body experiences a drag. (auth)

15394

THE OSCILLATING PLATE PROBLEM IN MAGNETOHYDRODYNAMICS. W. I. Axford (Univ. of Manchester, Eng.). *J. Fluid Mech.* **8**, 97-102(1960) May.

The oscillating plate problem is investigated for the case of an incompressible, electrically conducting fluid in the presence of a magnetic field. The boundary conditions are examined in detail, and a solution is found with the aid of suitable approximations. The motion of the fluid is shown to consist mainly of magnetohydrodynamic waves, but there is also a viscous boundary layer in which the solution agrees with that given by other writers. (auth)

15395

STABILITY OF PARALLEL FLOW IN A PARALLEL MAGNETIC FIELD AT SMALL MAGNETIC REYNOLDS NUMBERS. P. G. Drazin (Massachusetts Inst. of Tech., Cambridge). *J. Fluid Mech.* **8**, 130-42(1960) May.

The hydromagnetic stability of a basic two-dimensional parallel flow of an incompressible conducting fluid in a uniform magnetic field parallel to the flow is considered. By use of the generalization of the Orr-Sommerfeld equation for an electrically conducting fluid, it is shown that any given small wave disturbance can be stabilized by a sufficiently strong magnetic field if the Reynolds number is finite and the magnetic Reynolds number small. Stability of velocity profiles with a point of inflexion at small magnetic Reynolds number and infinite Reynolds number is considered in detail. Perturbation methods are developed to find stability characteristics in two cases, when the magnetic field is weak, and when the disturbance is a long

wave. These methods are applied to the jet and the half-jet, which are both found to be unstable to long-wave disturbances, however strong the magnetic field. Nonetheless, these two flows can be stabilized for any given harmonic disturbance of finite wavelength. The analysis of the jet reveals the surprising result that the magnetic field makes inviscid long-wave disturbances more unstable. (auth)

15396

FORMATION OF A PLASMA BY LOW ENERGY ION INJECTION AND CYCLOTRON HEATING. Tarō Dodo (Hitachi Central Research Lab., Tokyo). *J. Phys. Soc. Japan* **15**, 906-16(1960) May. (In English)

A new method was devised to produce a high temperature plasma by injecting an ion beam into a static magnetic mirror field. In this method, ions are injected along the axis of the d-c magnetic field lines and are given energy through the oscillating electromagnetic field of the cyclotron frequency. Therefore, the magnetic moments of ions are increased while it travels from one end of the mirror field to the other end. The injected ions are thus reflected at the opposite mirror end and some of them perform reciprocating motions between both ends. While an in-phase ion gets energy from the r-f field, an out-of-phase ion is decelerated and escapes from the mirror ends. The probability of trapping an injected ion is 0.3 to 0.5, depending on the strength of the oscillating field. As the ion current becomes large the injected ions are no longer trapped. In the device, the ion density will be limited to about $10^{12}/\text{cm}^3$. (auth)

15397

GROWTH OF SURFACE INSTABILITIES IN A LINEAR PINCHED DISCHARGE. R. Latham, J. A. Nation, F. L. Curzon, and A. Folkierski (Imperial Coll. of Science and Tech., London). *Nature* **186**, 624-5(1960) May 21.

Results are reported from experiments on the growth of instabilities in a linear pinched discharge in argon. These discharges were produced in a tube 15 cm in diameter and 50 cm long at pressures of 0.1 to 1.0 mm mercury and with currents of 40 to 150 kamp. Results revealed the presence of surface instabilities typical of many single-shot photographs of the discharge taken through the side of the tube with a Kerr cell camera. The irregularities on the plasma surface first appear when the column is expanding from the first axial bounce and grow while the plasma is being accelerated toward the axis of the discharge tube between the first and second bounces. (C.H.)

15398

NEW PRINCIPLE FOR HIGH-TEMPERATURE PLASMOIDS. A. A. Vlasov (Lomonosov Moscow State Univ.). *Sci. Sinica (Peking)* **8**, 266-87(1959) Mar. (In Russian)

The plasmoid state or the stationary motion of particles is characterized by a strongly defined cylindrical incidence of a beam with the radius defined by the external magnetic field, parallel to the beam axis and characterized by the mechanics of beam rotation and temperature distribution of velocities. A certain relation was found between the beam effective radius, temperature, and magnetic field. A function was derived for determining rotating particle distribution in the magnetic field. It is shown that rotation rate is a non-linear function of the cylindrical beam radius. Temperatures of 10^{10} to 10^{12} K are expected with respective magnetic field magnitudes and dimensions. At the periphery the beam rotates as a solid body with Larmor frequency and direction and not with cyclotron frequency. At certain conditions the derived distribution function confirms the plasmoid state. (R.V.J.)

15399

NON-LINEAR PHENOMENA IN A-C ELECTROMAGNETIC FIELD PLASMA. V. L. Ginzburg and A. V. Gurevich. *Uspekhi Fiz. Nauk* 70, 202-46(1960) Feb. (In Russian)

The non-linear equations of plasma dynamics (field equations and kinetic equations of plasma particles) are analyzed. Problems of the homogeneous electric field $E = E_0 e^{i\omega t}$ (the frequency ω is equal to zero, hence it is a constant feed) in non-relativistic and non-degenerate (classical) plasma and the linear effects appearing in plasma and in the ionosphere are discussed. 68 references. (R.V.J.)

15400

NUCLEAR FUSION—A POSSIBLE ENERGY SOURCE. Rolf Widerøe. *VDI Zeitschrift* 102, 45-53(1960) Jan. 11. (In German)

In recent years increased interest has been shown in the theoretical and experimental aspects of nuclear fusion. However, it is apt to take several decades before the fusion process can be put to large-scale practical use. It is still not known which types of heating and plasma stabilization will provide a means of releasing on an industrial scale the energy of nuclear fusion. The Zeta, Stellarator, and the Mirror Machine are described. (tr-auth)

15401

THE ORIGIN OF A "BACKWARD WAVE" IN A NON-MAGNETIZED PLASMA CYLINDER BOUNDED BY AIR. Winfried Otto Schumann (Technische Hochschule, Munich). *Z. angew. Phys.* 12, 145-8(1960) Apr. (In German)

It is shown that in a non-magnetized plasma column, "backward waves," i.e., waves with v_p and v_g of opposite signs, are possible. This is the case when the plasma is inhomogeneous and on its outer envelope a finite value of the electron density N or its eigenvalue $\omega_p = \Omega_w$ is present. This backward wave originates at the frequency $\omega = \Omega_w/\sqrt{2}$ and extends into the range of higher frequencies. (tr-auth)

15402

OSCILLATION OF A PLASMA CYLINDER IN AN AXIAL MAGNETIC FIELD. [PART] II. Klaus Körper (Max-Planck-Institut für Physik, Göttingen, Ger.). *Z. Naturforsch.* 15a, 220-6(1960) Mar. (In German)

Radial oscillations are excited in a homogeneous infinite plasma cylinder in a homogeneous axial magnetic field by a surface current which is homogeneous in the axial and azimuthal directions. The modes of oscillations corresponding to the axial and azimuthal components of current are not coupled, and so they may be analyzed separately. The magnetic field in the plasma and vacuum is obtained, and the indices of refraction for both types of oscillations are discussed thoroughly. When the currents are parallel to the external magnetic field, the oscillations are characterized by the refractive index of Eccles. On the other hand, when the current is perpendicular to the magnetic field two resonance frequencies exist, which depend on the density of the plasma and the magnetic field strength. In the latter case the radial characteristic oscillations of the plasma cylinder in an external magnetic field are considered. (auth)

15403

THE IMPEDANCE OF A COIL WITH A PLASMA AS A DIELECTRIC. Klaus Körper (Max-Planck-Institut für Physik, Göttingen, Ger.). *Z. Naturforsch.* 15a, 226-35 (1960) Mar. (In German)

From the basic equations of magnetohydrodynamics

the energy conservation theorem for plasmas is derived for events periodic in time. In addition to the terms known from vacuum electrodynamics, there are the kinetic energies of the electrons and ions and a term due to the oscillations of the electrons and ions in the magnetic field. With the help of the solution for the radially oscillating cylinder, the impedance of a coil containing the plasma is derived from general energy considerations. The impedance is discussed and its mean value in the range between two eigenfrequencies of the plasma cylinder is given. (auth)

15404

HIGH FREQUENCY HEATING OF A PLASMA CYLINDER IN AN AXIAL MAGNETIC FIELD. Klaus Körper (Max-Planck-Institut für Physik, Munich). *Z. Naturforsch.* 15a, 235-43(1960) Mar. (In German)

The conditions under which the effect of ion-electron scattering on radial oscillations near the ion resonance of an infinite plasma cylinder in an axial magnetic field may lead to a heating of the plasma, possibly sufficient to induce thermonuclear reaction, are examined. The magnetic field strengths needed to stabilize the plasma and the density of the plasma necessary to guarantee a sufficient rate of reaction require that one consider the optical behavior in the decimeter-wavelength range. In an equivalent model for the supplying circuit the reaction of the plasma is taken into account in a quantitative manner. Because of the finite extent of the plasma a dense spectrum of eigenresonances of the plasma system exists. Therefore the matching of the external circuit to the plasma is possible only in the mean. Numerical results are given for the energy absorbed, the radiative energy penetrating the plasma cylinder, and the corresponding reactive output, as functions of the plasma density, the temperature, and the frequency (near the "ion-resonance" = geometric mean value between the gyrofrequencies of the ions and electrons), when the oscillator and the plasma are optimally matched. (auth)

15405

MEASUREMENT AND EVALUATION OF ARC CHARACTERISTICS (Ar, N₂). H. Maecker (Siemens-Schuckertwerke, Erlangen, Ger.). *Z. Physik* 158, 392-404 (1960) Apr. (In German)

The field intensity-current intensity characteristics of cylindrical arcs depend, as was shown in an earlier treatment, in a significant manner on the electrical conductivity as a function of the heat current potential of the arc gas. Therefore, one can determine these important gas properties from the arc characteristics. The necessary evaluation method was derived on the basis of these relationships and applied to measurements in nitrogen arcs. For accurate measurements of the arc characteristics, the "cascade arc," in which the tube for the arc was constructed of water-cooled and centrally pierced Cu plates, was further developed so that 10 kw/cm arc columns can be reversed and a higher ionization degree can be assured. The results of this investigation are the characteristics of Ar and N₂, the $\sigma(S)$ curve of N₂, and finally the radiation density $u(\sigma)$ for N₂. (tr-auth)

15406

THE PRESSURE DEPENDENCE OF THE ELECTRON TEMPERATURE IN THE PLASMA OF THE POSITIVE COLUMN OF A GLOW DISCHARGE IN MOLECULAR GASES. Berth-Arnim Engelke (Technische Hochschule, Brunswick). *Z. Physik* 158, 422-32(1960) Apr. (In German)

In order to apply the Schottky diffusion theory of the positive column to glow discharges in molecular gases, it is necessary to consider the production of dissociation fragments of the molecule by electron collision. It was assumed that the dissociation leads to electrically neutral fragments. The origin or ionized dissociation products in the column plasma would be at least a two-stage ionization process. The radial electron density distribution in the cylindrically symmetrical problem is in this case describable by a non-linear differential equation from which, for two limiting cases with the boundary conditions, relations between the gas pressure and the electron temperature are derived. It was shown that in the range of average electron temperatures the effect of the dissociation on the pressure dependence of the electron temperature is especially significant. Whether the dissociation leads to an increase or decrease of the electron temperature depends on the magnitude of the ionization probability of the undissociated molecule, the ionization probability of the dissociation fragments, and the dissociation probability with respect to an electron collision. (tr-auth)

15407

INSTABILITY OF LONGITUDINAL OSCILLATIONS OF AN ELECTRON-ION PLASMA. L. M. Kovrizhnykh and A. A. Rukhadze. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 850-3(1960) Mar. (In Russian)

The instability of longitudinal oscillations of a low temperature electron-ion plasma is considered. The oscillations are always damped in an isotropic medium whereas in an anisotropic one, account of the ion motion may lead to the appearance of solutions which increase with time, that is, to instability. (auth)

15408

GYRORESONANCE ABSORPTION OF ELECTROMAGNETIC WAVES IN A PLASMA. B. N. Gershman. *Zhur. Eksptl'. i Teoret. Fiz.* **38**, 912-24(1960) Mar. (In Russian)

Absorption of normal waves in a homogeneous, magnetoactive plasma is determined by taking into account the thermal motion of the electrons in a frequency range lying near the gyrofrequency and multiple frequencies. Collisions as well as the absorption mechanism specific of the plasma are taken into account. (auth)

Shielding

15409

SHIELDING OF GAMMA RADIATION (RADIATION PROTECTION IN REACTORS AND IN INDUSTRIAL NUCLEAR PLANTS). M. Oberhofer and T. Springer (Technische Hochschule, Munich). *Kerntechnik* **2**, 124-6(1960) Apr. (In German)

The fundamentals for the rough calculation of gamma shielding are presented. The absorption law, the half-value layer and 1/10 value layer, and the shielding of gamma radiation by thick absorbers greatly expanding laterally are discussed. (J.S.R.)

Theoretical Physics

15410 AFOSR-TN-60-186

Rochester, N. Y. Univ. Inst. of Optics.
CORRELATION THEORY OF STATIONARY ELECTROMAGNETIC FIELDS. II. CONSERVATION LAWS. Technical Note No. 2. P. Roman and E. Wolf. Feb. 1960. 21p. Contract AF49(638)-602. OTS.

Two second-order space-time correlation tensors

$W_{jk}(\underline{x}_1, \underline{x}_2, \tau)$ and $L_{jk}(\underline{x}_1, \underline{x}_2, \tau)$, associated with stationary electromagnetic fields in free space, are considered. The parameters \underline{x}_1 and \underline{x}_2 are position vectors of two points and τ is a time delay. These tensors are intimately related to certain generalizations of the (time averaged) energy density and the energy flow vector. Differential equations which W_{jk} and L_{jk} satisfy in free space are derived, and from them four new conservation laws are deduced. In the limit $\underline{x}_1 \rightarrow \underline{x}_2$, $\tau \rightarrow 0$ two of these laws reduce to the usual laws (in time averaged form) for the conservation of the energy and the momentum in an electromagnetic field. The other two laws reduce only to trivial identities in this limit, so that they have no analogy in the framework of the usual theory. (auth)

15411

EIGENFUNCTIONS WITH DEFINITE SYMMETRY FOR THE WAVE FUNCTIONS OF A SYSTEM OF THREE IDENTICAL PARTICLES. Gilbert Munsch, Philippe Pluvineau, and Joseph Proriot (Faculté des Sciences, Strasbourg). *J. phys. radium* **21**, 85-93(1960) Feb. (In French)

As a first step in the precise study of the quantum radial problem for a system of three identical particles, a method of building orthogonal sets of eigenfunctions with definite character of symmetry is given. Rather than the three linear distances of the particles, three variables more closely related to a representation of the symmetric group S_3 are chosen. The first is not affected by permutations. The two others are transformed in a simple way, and it is possible to form with them polynomials of definite symmetry. These polynomials are determined as eigenfunctions of two commutable operators. Explicit expressions are given up to the fifth degree which seems quite sufficient for practical purposes. (auth)

15412

EXPANSION THEOREM OF DENSITY MATRIX, VIRIAL EXPANSION AND NEW FORMULA OF MULTIPLE SCATTERING. Toshio Yokota (Inst. of Statistical Mathematics, Tokyo). *J. Phys. Soc. Japan* **15**, 779-94(1960) May. (In English)

Expansion formulas for density matrices are derived with the use of the calculus of ordered exponentials. Using the formulas the expressions for virial coefficients are explicitly obtained. The expression of the third virial coefficient is calculated to obtain its expansion formula in terms of $\hbar^2\beta/M$. The expansion formulas for density matrices can be used to derive a new formula of multiple scattering which involves Luttinger and Kohn's formula as a special case. The expansion formula for the normalized density matrix is also given. Expansion formulas which are to be applied to irreversible processes and relaxation phenomena are also given. (auth)

15413

THE TREATMENT OF THE QUANTUM MECHANICAL MANY-BODY PROBLEM WITH TWO-BODY FUNCTIONS. E. Kröner (Technische Hochschule, Stuttgart). *Z. Naturforsch.* **15a**, 260-5(1960) Mar. (In German)

According to Bopp, with each quantum mechanical problem of N similar symmetrical particles, which react with each other only with two-body forces, a two-particle problem is correlated rigorously. Every $N/2$ solution ϕ_n of this problem was collected in products from which configurations were obtained by antisymmetrization. The pertinent series development should converge much better than all developments based on single particle functions.

Difficulties arising in the calculation of the energy-matrix elements pertinent to the configurations and overlapping integrals can be overcome to a great extent. (tr-auth)

15414

SCATTERING BY A SINGULAR POTENTIAL IN PERTURBATION THEORY AND IN THE MOMENTUM REPRESENTATION. Ya. B. Zel'dovich. *Zhur. Eksptl'. i Teoret. Fiz.* 38, 819-24 (1960) Mar. (In Russian)

A method is developed for the treatment of scattering by a singular potential in the momentum representation and in perturbation theory. Application of such renormalization technique permits one to derive familiar results for the cross section despite the fact that the integrals diverge and the matrix elements entering in the wave equation in the momentum representation vanish. (auth)

15415

DEPENDENCE OF THE INTERNUCLEAR POTENTIAL PARAMETERS ON THE PARTICLE NUMBER. M. Ya. Amus'ya. *Zhur. Eksptl'. i Teoret. Fiz.* 38, 834-42 (1960) Mar. (In Russian)

The dependence of the oscillator potential parameters on the number of nucleons is determined on the assumption that the mean energy per nucleon in the nucleus is constant. The possible influence of three-particle interaction is considered. (auth)

15416

DISPERSION AT VERY LARGE DENSITIES AND TEMPERATURES OF THE MEDIUM. G. S. Saakyan. *Zhur. Eksptl'. i Teoret. Fiz.* 38, 843-9 (1960) Mar. (In Russian)

The dispersion properties of a medium are investigated at high densities and temperatures, that is, under conditions which may exist in the inner regions of irregular stars (white super dwarfs). Single photon annihilation and electron pair creations occur at electron densities $N_e \approx 10^{32} \text{ cm}^{-3}$. Scattering of electromagnetic waves is not due to electrons but to nucleons. At such frequencies and densities the refraction index is approximately $n \sim 1 + 1.05 \times 10^{-41} N$ where N is the neutron density. Hard Cherenkov radiation may occur in a medium of the discussed type. (auth)

15417

PERIPHERAL INTERACTION OF NUCLEONS IN THE TWO-MESON APPROXIMATION. A. F. Grashin and I. Yu. Kobzarev. *Zhur. Eksptl'. i Teoret. Fiz.* 38, 863-9 (1960) Mar. (In Russian)

Triplet nucleon-nucleon scattering phase shifts are computed in the two-meson approximations for nonrelativistic energies. Comparison of the two-meson and one-meson phase shifts shows that the one-meson approximation is very exact for all mixing parameters (beginning from ${}^3S - {}^3D$). This permits the use of theoretical mixing parameter values in phase analysis for choosing the unique solution. The peripheral part of the two-meson potential corresponding in the first Born approximation to the scattering amplitude obtained is derived. (auth)

15418

EFFECT OF DEFORMATION OF THE NUCLEUS ON THE ELECTRON WAVE FUNCTIONS. APPLICATION TO β -DECAY. R. Vayner and Kh. Yusim. *Zhur. Eksptl'. i Teoret. Fiz.* 38, 870-6 (1960) Mar. (In Russian)

The effect of quadrupole interaction on the wave functions of the electron-nucleus system is studied. The electron and nuclear variables cannot be separated in the case of nonspherical nuclei. As a consequence satellite nuclear i and electron j angular momenta appear which satisfy the inequalities $|i - I_0| \leq 2$ and $|j - J_0| \leq 2$ where I_0 and J_0 are

the total nuclear and electron angular momenta in the absence of quadrupole interaction. The wave function for the electron-nucleus system is determined by perturbation theory methods for nuclei with axial symmetry. The explicit expression of the wave functions in the region $r \leq R$ (R is the nuclear radius) is presented. Satellite states lead to the appearance of new matrix elements which in some cases significantly change the probability of the corresponding transitions. In the case of β -decay for $Z \sim 70$, $Q_0 \sim 5 \cdot 10^{-24} \text{ cm}^2$, and $\Delta I \geq 3$, where ΔI is the difference between the initial and final state nuclear spins, the new matrix elements may exceed those computed without account of this effect by 1-2 orders of magnitude. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

15419 HW-56881

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

STATUS OF THE WATER-WALL DEVELOPMENT PROGRAM WITH MODEL STUDY RESULTS. W. J. Morris. Aug. 1, 1958. 10p. Contract [W-31-109-Eng-52]. OTS.

A water-wall concept was proposed as a method of supplying large quantities of coolant to reactors of the Hanford type. A summary of results obtained in hydraulic model testing is presented along with recommendations for future action. (J.R.D.)

15420 HW-64456

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PRTR FUEL ELEMENT RUPTURE TEST FACILITY: APPLICATION TO POWER REACTOR FUELS. W. E. Roake. Mar. 3, 1960. 4p. Contract AT(45-1)-1350. OTS.

A review of the potential usefulness of the proposed facility for testing defected fuel elements at the PRTR is reviewed. It is noted that such a facility would contribute directly to improved fuel element concepts including full core length, non-segmented, non-sintered UO_2 fuel, and fuel elements clad with new, better, and cheaper materials. (J.R.D.)

15421 HW-SA-1830

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SEMICONDUCTOR SWITCHING FOR NUCLEAR REACTOR CONTROL (thesis). Joseph Hugh Greer. 1960. 49p. Contract [AT(45-1)-1350]. OTS.

Submitted to Univ. of Idaho.

Results of an investigation to determine the usefulness of semiconductor switches in reactor control are presented. The prospects for application of semiconductor switches in heavier power circuits seems promising, as does their use in controlling short-circuit currents. It is concluded that maintenance costs should be low. Other observations relating to present and expected production costs and future applications are also discussed. (J.R.D.)

15422 HW-SA-1838

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

HEATING, VENTILATING, AND AIR CONDITIONING OF THE PLUTONIUM RECYCLE TEST REACTOR (thesis). Leland Jerome Nitteberg. 1960. 97p. OTS.

Submitted to Univ. of Idaho.

The designs of air conditioning systems installed in the Plutonium Recycle Test Reactor are described. The reac-

tor facility is briefly described and sketches of the facility and core are included along with reduced-size copies of construction drawings. (J.R.D.)

15423 KAPL-M-D1G-TD-10

Knolls Atomic Power Lab., Schenectady, N. Y.
HILO—A STEADY STATE REACTOR ANALYSIS PROGRAM. A. E. Kakretz and L. B. Shannon. Apr. 1, 1960. 108p. Contract W-31-109-Eng-52. OTS.

A digital computer program, designated HILO, has been developed to perform steady state thermal analyses of one and two pass pressurized water reactors. Given the prime variables system pressure, system flow, system average temperature, and reactor power, HILO will determine the thermal margins: maximum fuel temperature, margin to nucleate boiling, and departure from nucleate boiling ratio. Up to five values of each of the prime variables can be investigated in any problem. HILO will determine the thermal margins for all combinations of the prime variables for up to four hot channels in each reactor pass. HILO has been designed to solve the flow redistribution problem for single phase and two phase flow in the hot channels. The flow redistribution solution assumes that the hot channel pressure drop is equal to a constant times the average channel pressure drop. (auth)

15424 NP-8628

Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H.
Institut für Neutronenphysik und Reaktortechnik,
Karlsruhe, Germany.

NUMERISCHE BERECHNUNG HETEROGENER REAKTOREN. BERICHT NR. 16. (Numerical Calculation of Heterogeneous Reactors. Report No. 16). F. Stummel. Jan. 22, 1960. 75p.

Calculations are made for a cylindrical heterogeneous reactor with cylindrical fuel elements, control rods, and channels. The flux distribution must be described by multigroup diffusion theory, and for simplicity a two-group diffusion equation is solved. Since the flux distribution parallel to the long axes of the rods is known, the problem reduces to a determination of the fast and thermal fluxes for a cross section of the reactor at right angles to the long axes of the rods and channels. (T.R.H.)

15425 NP-tr-428

ESTIMATION OF THE TEMPERATURE INCREASE OF THERMAL NEUTRONS IN THE FUEL ELEMENTS OF HETEROGENEOUS REACTORS. Albert Muller. Translated by Robert Gordon (Univ. of California, Berkeley) from *Nukleonik* 1, 172-4(1959). 12p. JCL.

A formula is derived for estimating the temperature increase of thermal neutrons in the fuel elements of heterogeneous reactors due to scattering in the moderator when the average energy transfer to a thermal neutron is accurately known. (C.J.G.)

15426

TECHNICAL SAFETY INSPECTION IN THE BUILDING OF NUCLEAR REACTORS. A. Kuhlmann and O. Kellermann (Technischer Überwachungs-Verein Köln e. V., Aachen). *Atomwirtschaft* 5, 166-71(1960) Apr. (In German)

The German federal law requires an engineering safety inspection. The preliminary testing, building inspection, and acceptance testing of a gas-cooled reactor are described as an example. (J.S.R.)

15427

THE CHARACTERISTICS OF HOMOGENEOUS NEUTRON AMPLIFIERS. I. NEUTRON AMPLIFIERS WITHOUT REFLECTORS. Gyorgy Fodor (Budapest Technical Univ.). *Energia és Atomtech.* 12, 245-54(1959) May-June. (In Hungarian)

The multiplication factors of spherical homogenous neutron amplifiers, without reflectors, are studied. The fuel is uranium, in the form of uranyl sulfate, dissolved in water or heavy water moderators. It is assumed that the neutron source is located in the center of the sphere. It is found that if the reactivity (s = the ratio of the actual radius in proportion to the critical radius) is kept constant, the characteristics of the neutron amplifiers depend partially on the dilution ratios (of moderator and fuel) and partially on the U^{235} concentration. The three basic characteristics are K , Z , and K_z , where K is the multiplication factor, Z is the total cost of the fuel and the moderator, and $K_z = K/Z$, the ratio of multiplication per unit of cost. K and Z generally vary proportionately: the higher the multiplication, the higher the moderator and fuel requirement and, consequently, their cost. There is always a K_z ratio that can be regarded as the optimum. Detailed computations are given for each of the two moderators. With increasing concentrations of U^{235} the K and Z characteristics drop but the K_z ratios rise. Comparisons show that D_2O is not an economical moderator, because H_2O generally gives better multiplication factors and lower costs. A neutron amplifier operating on natural uranium requires D_2O as a moderator, and its cost offsets the advantages of cheaper fuel. In a definite subcritical system (an infinite system in which the reactivity is less than 1.0) a substantial multiplication can be obtained only at the expense of very large size and high cost. The characteristics of water-moderated and heavy-water-moderated neutron amplifiers are tabulated and compared according to degrees of enrichment (0.71, 2, 6, 20, 50, and 100%). In each case the reactivity is 0.9, and the K_z ratio is maximum. The costs are based on prices of \$40/kg for natural uranium, \$15/g for pure U^{235} , and \$250/kg for heavy water. For reactivities other than 0.9 the values of K can be converted on the basis of a graph of reactivity as a function of thermal neutron flux. Similarly, the values of K/Z can be computed on the basis of a graph of reactivity as a function of fast neutron flux. (JPRS)

15428

THE CHARACTERISTICS OF HOMOGENEOUS NEUTRON AMPLIFIERS. II. REFLECTED NEUTRON AMPLIFIERS. Gyorgy Fodor (Budapest Technical Univ.). *Energia és Atomtech.* 12, 482-92(1959) July-Aug. (In Hungarian)

The characteristics of spherical homogenous neutron amplifiers, moderated with water or heavy water and equipped with suitable reflectors, are studied. It is found that a reflector around the core reduces the critical flux and slightly raises the multiplication factor. If the moderator is water, a reflector of infinite thickness is desirable. For D_2O a reflector thickness can be found at which both the multiplication factor and the cost are most favorable. The interrelation between the multiplication factor and reactivity is about the same as when no reflector is used. The necessary corrections can be made on the basis of presented graphs. A comparison of the two moderators shows that with respect to the multiplication factor, and particularly to the cost, H_2O is the better moderator. These computations were made for enriched uranium fuel containing 20% U^{235} , but the results are generally applicable. Natural uranium is an exception because with water it can produce only a definite subcritical system. But even with D_2O and natural uranium the costs are prohibitively high. If water-moderated homogenous neutron amplifiers are used it is possible to find for any concentration of U^{235} a dilution ratio at which the fuel cost is minimum. Either this state or the one that gives the highest ratio of multiplication per unit cost can be regarded as the optimum. A higher U^{235} concentration reduces the multiplication factor

and more so the fuel cost. The effects of a reflector around the neutron source are studied. If water is the moderator, a small reflector around the neutron source slightly increases the multiplication factor, but generally the increase in the amount of fuel required is even higher. If D_2O is used, even the multiplication factor drops. Consequently, the use of a reflector around the neutron source is not practical. (JPRS)

15429

ACTIVITY OF THE COOLING SYSTEM IN WATER-COOLED REACTORS. Zoltan Gyimesi (Central Physics Research Inst., Lab. of Reactor Physics and Engineering). *Energia és Atomtech.* 12, 606-11(1959) Dec. (In Hungarian)

The neutron-induced activity in the chemically pure water of the cooling system is described, with special emphasis on the $O^{16}(n,p)N^{16}$ reaction. The fast neutron flux in the critical zone and the activation cross section are explained. Equations are given for computing the activity of any daughter product in a theoretical cc of water along its path in the cooling system of a simple model. Possible sources of water pollution and their effects on neutron-induced activity are reviewed briefly. (JPRS)

15430

WATER SUSPENSION REACTORS. Milan Poděšf and Ivo Zvára (Czechoslovak Academy of Sciences, Prague). *Jaderna Energie* 6, 120-4(1960). (In Czech.)

A survey is given of materials from the second Geneva conference and of previous data dealing with chemical and engineering problems of suspension reactors. An economic and technical evaluation of aqueous homogeneous reactors is made and compared with suspension reactor problems. (auth)

15431

THE INFLUENCE OF THE GEOMETRIC SYMMETRIES OF A HETEROGENEOUS REACTOR ON THE FLUX DISTRIBUTION. Lawrence Dresner (Oak Ridge National Lab., Tenn.). *Nukleonik* 2, 45-7(1960) Apr. (In English)

In a bare, homogeneous reactor the space and energy dependences of the flux are separable under quite general assumptions. In the present paper this theorem is extended to some heterogeneous reactors. It is found that for certain heterogeneous reactors of special shape and geometric symmetry, there are eight networks of points each with the following properties: (i) the space and energy dependence of the flux is separable at these points; the spectrum is thus the same at all points of a network, and (ii) the space dependence of the flux over a network is the same as that of the flux in a homogeneous reactor lying inside the same boundary. (auth)

15432

THE CLOSED SOLUTION OF THE STATIONARY MULTIGROUP DIFFUSION EQUATION OF A REFLECTING SPHEROIDAL REACTOR AND THE ADAPTATION OF THE CYLINDRICAL REACTOR TO THE SPHEROIDAL REACTOR. Ferdinand Cap and Horst Reimann. *Nukleonik* 2, 47-54(1960) Apr. (In German)

As is known the problem of a reactor homogeneously reflecting on all sides, whose flux distribution depends on more than a position coordinate, was solved earlier by approximation methods. For the practically important case of the cylindrical reactor reflecting on blanket and casing, Marchuk, Ziegler, et al. present various approximation methods which satisfy in good approximation the calculation of critical volumes. However, with these methods it is not possible to make reliable assumptions on the flux distribution of single neutron groups. By introduction of

rotational elliptical coordinates, it is easy to solve rigorously the multigroup diffusion problems of a reflecting spheroidal reactor so that any number of energy groups and reflector shells can be assumed. The flux distribution yields in the non-stationary case successive spheroidal functions. In the critical state only two eigenfunctions remain. A special investigation then shows that a cylindrical reactor can be approximated through a spheroidal reactor. (tr-auth)

15433

THE THEORY OF RESONANCE ABSORPTION OF NEUTRONS IN HETEROGENEOUS REACTORS. [PART] I. Albert Müller (Siemens-Schuckertwerke A. G., Erlangen, Ger.) *Nukleonik* 2, 54-67(1960) Apr. (In German)

For the calculation of the resonance absorption in piece-meal homogeneous reactor cells, an integral equation system was derived from the energy-dependent transport equation and it was solved systematically by iteration. The previously known approximations for the resonance integral are improved and generalized in complicated geometries. From the approximation solution, producible after a single iteration in closed form, for the temperature $T = 0^\circ K$, it is shown in Part II that it is in general sufficiently accurate. The theory was applied to single cylindrical rods, spheres, and plates and to periodic plate lattices of UO_2 . In the case of the single rod, good agreement with the experimental values of Hellstrand was obtained with consideration of the temperature correction. (tr-auth)

15434

THE THEORY OF RESONANCE ABSORPTION OF NEUTRONS IN HETEROGENEOUS REACTORS. [PART] II. Albert Müller (Siemens-Schuckertwerke A. G., Erlangen, Ger.) *Nukleonik* 2, 67-73(1960) Apr. (In German)

The formulas derived in Part I for the resonance integral were tested for their accuracy. Then the complete resonance integral for single cylindrical rods, spheres, and plates and for periodic plate lattices of UO_2 was calculated. In a consideration of the temperature correction the theoretical values for single rods agree well with the experimental values of Hellstrand. (tr-auth)

15435

REACTOR SAFETY. Gudbrand Jenssen. *Tek. Ukeblad* 106, No. 7, 3p.(1959). (In Norwegian)

An outline is given of the acceptable hazards for a nuclear power plant, and the decisive factors in their evaluation are reviewed. (auth)

15436

Oak Ridge National Lab., Tenn. NUCLEAR SAFETY. Technical Progress Review, Vol. 1, No. 3. W. B. Cottrell, ed. 1960. 92p. \$0.55(GPO) (domestic), \$0.70(GPO)(foreign).

Topics are considered which are relevant to the analysis and control of hazards associated with nuclear reactors, operations involving fissionable materials, and products of nuclear fission. Primary emphasis is on safety in reactor design, construction, and operation; however, safety considerations in reactor fuel fabrication, spent-fuel processing, nuclear waste disposal, and related operations are also treated. (W.D.M.)

15437

IMPROVEMENTS IN OR RELATING TO CONTROL ROD ASSEMBLIES FOR NUCLEAR REACTORS. (to Westinghouse Electric Corp.). British Patent 834,365. May 4, 1960.

A coupling device is described for detachably engaging the control rods of a pressurized water reactor. The

mechanism is simple and convenient, latches onto arms extending radially from the control rod, and releases quickly. (T.R.H.)

15438

HIGH FLUX HOMOGENEOUS NUCLEAR PROCESS AND REACTOR WITH CIRCULATING FISSIONABLE MATERIAL. (to Esso Research and Engineering Co.). British Patent 834,371. May 4, 1960.

A homogeneous reactor is described which has neutron-absorbing material disposed about the core inlet and outlet to prevent criticality. The cooling takes place mostly outside the core so that high fluxes and power levels are possible. The fuel can be a solution, gas, or fluidized solid. (T.R.H.)

15439

IMPROVEMENTS IN OR RELATING TO HETEROGENEOUS NUCLEAR REACTORS. Kenneth Henry Dent (to United Kingdom Atomic Energy Authority). British Patent 835,764. May 25, 1960.

A charge-discharge system for graphite reactors is described. An arm and lever system permits access to 16 fuel channels through one port. (T.R.H.)

15440

IMPROVEMENTS IN OR RELATING TO COOLING OF NUCLEAR REACTORS. Richard Phillip Kinsey (to United Kingdom Atomic Energy Authority). British Patent 835,947. May 25, 1960.

A reactor cooling system is presented in which ducts through the biological shield allow convection flow of coolant in a circuit over the core vessel and over the walls of the containment vessel. The core is supported in a core vessel surrounded by the biological shield. The fuel elements are cooled by liquid Na which is cooled by gas circulating upward around core and heat exchangers and downward along the outermost containment vessel. (T.R.H.)

Power Reactors

15441 AECU-4355

Booz-Allen Applied Research, Inc., Glenview, Ill.

A STUDY OF THE FEASIBILITY AND ECONOMICS OF RADIOISOTOPE PRODUCTION IN POWER REACTORS.

Final Report. C. B. Magee, J. E. Fulenwider, G. J. Rotariu, and R. P. Petersen. Feb. 1960. 141p. Contract AT(11-1)-736. OTS.

The specific and total activities of six representative radioisotopes that could be produced in three types of power reactors are determined. The isotopes considered were Co^{60} , H^3 , C^{14} , P^{32} , Na^{24} , and K^{42} . The three reactors were the Dresden BWR, Piqua OMR, and Shippingport PWR. An economic analysis was made. (W.D.M.)

15442 ANL-6148

Argonne National Lab., Lemont, Ill.

A PRELIMINARY DESIGN STUDY OF A BOILING SLURRY REACTOR EXPERIMENT. M. Petrick and J. F. Marcha-terre. Apr. 1960. 39p. Contract W-31-109-eng-38. OTS.

An experiment is described which would test the feasibility of the boiling slurry reactor concept and investigate its potential as a practical nuclear power reactor. The experiment would yield data and information on reactor stability and safety characteristics, performance parameters, feasible slurry concentration limits, behavior of slurries under actual reactor operations, rates of radiolytic gas evolution, rates of fission gas release, etc. (auth)

15443 APAE-41(Vol.I)

Alco Products, Inc., Schenectady, N. Y.

INTERMEDIATE HEAT EXCHANGER PRELIMINARY DESIGN. Feb. 28, 1959. 235p. Contract AT(11-1)-666. OTS.

A conceptual study of design of sodium-cooled reactor intermediate heat exchangers (IHx) is presented. The purpose of this unit is to transfer heat to a nonradioactive fluid which circulates through the steam generator. Since the unit is inaccessible, trouble free operation is emphasized. A detailed description of the preliminary design and analysis is given. (See also APAE-41 Vols. II and III.) (J.R.D.)

15444 APAE-41(Vol.II)

Alco Products, Inc., Schenectady, N. Y.

STEAM GENERATOR PRELIMINARY DESIGN. Feb. 28, 1959. 286p. Contract AT(11-1)-666. OTS.

A conceptual study on design of sodium-cooled reactor steam generators was conducted. Included is a detailed description of the preliminary design and analysis, based on the use of known materials and existing methods of fabrication. (See also APAE-41 Vols. I and III.) (J.R.D.)

15445 APAE-41(Vol.III)

Alco Products, Inc., Schenectady, N. Y.

INTERMEDIATE HEAT EXCHANGER AND STEAM GENERATOR CONCEPT STUDY. Feb. 28, 1959. 206p. Contract AT(11-1)-666. OTS.

Development of preferred designs in accordance with A.E.C. specifications for sodium-cooled reactor intermediate heat exchanger and boiler are reported. The field of possibilities was narrowed by consideration of all concepts and elimination of designs which do not meet basic requirements. The work performed from the initial concept to selection of the preferred design prior to final rating is covered. (See also APAE-41 Vols. I and II.) (J.R.D.)

15446 APAE-Memo-257

Alco Products, Inc., Schenectady, N. Y.

SPECIFICATIONS AND FABRICATION PROCEDURES FOR SM-1A CORE II CONTROL ROD FUEL ELEMENTS. May 13, 1960. 97p. Contract AT(30-3)-326. OTS.

Stainless steel-base fuel components of thin plate-type construction and containing a dispersion of UO_2 were successfully employed in powering the Army Package Power Reactor. The component is designed for radioactive service in pressurized water and consists of sixteen composite fuel plates joined into an integral unit or assembly by brazing. Specifications covering loading, materials, and processing are presented. A list of applicable drawings and the process flow diagram are included. (auth)

15447 ATL-A-107

Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.

VARIABLE MODERATOR REACTOR DEVELOPMENT PROGRAM. Quarterly Progress Report No. 3. Feb. 29, 1960. Includes Attachments: I. KINETICS MODEL FOR BOILING WATER REACTORS. Fred E. Romie. (ATL-266 Preliminary). II. BOCH—A PROGRAM FOR COMPUTING THE HYDRODYNAMIC PERFORMANCE OF BOILING WATER REACTORS. Fred E. Romie, John O. Bradfute, and Haruo Isakari. (ATL-228 Preliminary). III. PUREE'—A METHOD AND CODE FOR THE CALCULATION OF PHYSICS PROPERTIES OF H_2O -MODERATED POWER REACTORS. J. W. Webster, R. I. Sutton, and J. M. McCampbell. (ATL-229 Preliminary). 147p. Contract AT(04-3)-250, Project Agreement No. 3. OTS.

The hydrodynamics code BOCH and the physics code

PUREE' were used in the analysis of specific VMR cores. Eight core designs of different geometries were selected for initial evaluation. Extensive analysis of the first of these cores was completed, and more general analysis of the other cores is in progress. The analog representation of the VMR kinetics was completed and applied to the analysis of the VMR over a large range of parameters for curves of positive void versus reactivity. Further checks of the first three energy groups of PUREE' against experimental data were completed. The P₃-POP method of computing the thermal group constants was used in conjunction with the first three groups to analyze the reference core designs and the critical experiment. The more complex blackness method of computing the PUREE' thermal group constants appeared to be functioning properly and is being checked on very tight lattices to determine the magnitude of the change in fuel-pin blackness due to incident neutron distortion by neighboring fuel pins. Mechanical and system design of selected cores was started. Corrosion rate of the moderator systems was computed, and preliminary analysis of a clean-up system was started. (For preceding period see ATL-A-103.) (W.D.M.)

15448 BAW-1116

Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.

LIQUID METAL FUEL REACTOR EXPERIMENT QUARTERLY TECHNICAL REPORT [FOR] APRIL 1958--JUNE 1958. 176p. Contract AT(30-1)-1940. OTS.

Design studies and related work in physics, reactor engineering, chemistry, materials and inspection and in reactor kinetics were continued. Activities in these areas are summarized. Preparation of spectrographic standards for chemical analyses included several new procedures for the purification of bismuth to decrease iron, and chromium. Analytical work for various LMFRE tests included 1,642 separate determinations on 307 samples. Mercury and mercury vapor procedures were used in the cleaning of specimens, components, and a bismuth test loop. Contract work on uranium solubility was completed and a report is being written. The test apparatus for sodium-bismuth leak testing has been completed and the size of the controlled leak was calibrated using water. Results of corrosion work in the dynamic test loops showed the value of the zirconium additive in reducing corrosion. Improvements to the loops have reduced cold locations which could collect uranium and reduce loop concentrations. Corrosion of hot zones and metal transport of the loop material to cold areas have been noted, particularly on the loops with low zirconium concentration. Capsule testing has shown metal transport and corrosion at the higher temperatures under which this screening test has been operating. In addition to Croloy 2 $\frac{1}{4}$ and 1 $\frac{1}{4}$ the capsules included beryllium, tantalum, and other alloys, preparatory to use in test loops. The initial stress-rupture and creep information on Croloy 2 $\frac{1}{4}$ and 1 $\frac{1}{4}$ in liquid bismuth fuel solutions compares well with that in an air atmosphere. Impact data at operating temperature show an improvement after aging. The outgassing of graphite has begun and other graphite projects have been discussed. Graphite seals and weepage tests await receipt of specimens. Preparation of graphite pellets with impregnant materials included, indicates that subsequent oxidation to form the metal oxides will be difficult. The formation of carbides appears promising and is now under investigation. Design of apparatus and test procedures for checking instrumentations for temperature, pressure, liquid level, and flow is complete. Most of the apparatus is complete and tests will begin

as prototype instruments are received. Work on the prototypes of various components is very active. Beryllium is on hand and dry box equipment and other health safety requirements are being prepared for development of the "thimble." The 2 $\frac{1}{2}$ in. test loop for the testing of valves and other components is almost complete. Initial induction heating tests indicated excessive gradients, and revisions are now being tested. Test apparatus for cavitation and for new projects on the testing of valves, filters, and bellows are complete in most cases and await receipt of specimens for the initial proof tests. A sparging device tested with water and mercury is being placed in the first in-pile test loop. Assembly of the in-pile loop for the ETR reactor is almost complete. The inpile section for the critical facility test as Arco has been shipped. Design of loop No. 3 (MTR) is almost complete and construction of components is underway. The investigation of welding procedures for remote operation has produced successful welds on 2 $\frac{1}{2}$ -in. OD \times 0.250-in. wall and 6 $\frac{5}{8}$ -in. OD \times 0.313-in. wall steels. Additional work is underway on other sizes and with tubing on which a bismuth film remains from operation. The consumable arc, gas-shielded welding process has been discontinued. The Engineering Prototype Development Facility was leased and renovated for the developmental testing of LMFRE-I maintenance equipment and operational mechanisms. The first draft of a maintenance reference design report has been prepared and released. This report elaborates upon functions of maintenance equipment, more fully explains techniques and procedures to be utilized in typical plant maintenance operations, and presents information on associated research and development programs. Magnesium, selenium, and zirconium have been tried as dispersing agents of slurries. It was found that magnesium reduces thorium to thorium metal. The stability of the slurry and the effect of agglomerates are being studied. The bismuth in the slurry test loop has been dumped into the sump and is being kept molten with the intent of starting circulation upon determination of detailed slurry specifications. Croloy 1 $\frac{1}{4}$ was selected as the reactor secondary containment material because it meets design temperature requirements (1050 F), and all welds made in the field can be stress relieved during original system heatup. (auth)

15449 BAW-1131

Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.

CRITICAL EXPERIMENTS FOR THE N. S. SAVANNAH CORE. R. M. Ball, A. L. MacKinney, J. H. Mortenson, D. A. Ross, and D. V. P. Williams. [1958]. 18p. OTS.

Presented at the American Nuclear Society Meeting in Detroit, Michigan, on December 10, 1958.

A study of the nuclear and engineering parameters of the N. S. Savannah reactor core is described. UO₂ enriched to 4% U²³⁵ in the form of stainless steel clad pins was arranged in critical arrays with water/UO₂ volume ratios of 1.54 and 1.15. Data on buckling and differential change in reactivity with water height measurements are included along with results of control rod hold-down worth experiments and power distribution measurements. (J.R.D.)

15450 CF-60-4-79

Oak Ridge National Lab., Tenn.

A STUDY OF THE FUEL VALUE OF U²³³. S. Jaye, L. L. Bennett, and M. P. Lietzke. Apr. 11, 1960. 103p. OTS.

The fuel value of U²³³ was calculated for five thermal reactors (Dresden, Yankee, Carolinas-Virginia, Hallam, GCR-II). Relative to a U²³⁵ value of \$17 per gram, pure U²³³ had a value that varied from \$18.2 to \$20.2 per gram.

U^{233} contained in once- and twice-recycle uranium from an initial U^{233} -Th cycle had a value slightly in excess of the value of pure U^{233} . The value of U^{233} in recycle uranium from an initial U^{233} -Th cycle was less than that for pure U^{233} and decreased with each succeeding cycle. (auth)

15451 CRR-907

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

PROSPECTS FOR URANIUM CONSUMPTION IN THE CANADIAN POWER REACTOR PROGRAM. G. T. Leaist. Mar. 1960. 19p.

In the search for economic power from nuclear energy a number of reactor designs have emerged as possible contenders. The effect on the demand for uranium that may result from the employment of different reactor designs is compared to the effect due to the varying cost of power from nuclear reactors. The reactor designs considered were CANDU, SENN, gas cooled graphite moderated, PWR-pressurized water, BWR-boiling water, and OCR-organic cooled and moderated. (W.D.M.)

15452 HPR-5

Norway. Institutt for Atomenergi, Halden.

A TRANSFER FUNCTION MODEL OF THE HBWR PLANT. H. Schmidl, G. Ambrosini, N. Rydell, and O. Vapaavuori. Mar. 1960. 84p.

A transfer function model was developed for the core and load circuits of the HBWR. The plant model is divided into sections such as neutron kinetics, fuel temperature kinetics, coolant and moderator dynamics, and load circuit dynamics. (J.R.D.)

15453 IDO-28549

Aerojet-General Nucleonics, San Ramon, Calif.

ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM SEMIANNUAL PROGRESS REPORT FOR JULY 1 THROUGH DECEMBER 31, 1959. Feb. 15, 1960. 254p. Contract AT(10-1)-880. OTS.

The Army Gas Cooled Reactor System Program includes four projects: The Gas Cooled Reactor Experiment I (GCRE-I); the Gas Cooled Reactor Experiment II (GCRE-II); the ML-1 (a mobile, low power nuclear power plant); and the Gas Turbine Test Facility (GTTF). Building and construction, reactor design and development, reactor instrumentation, and fuel element development and fabrication for GCRE-I are covered. Capsule loop tests and neutronics for GCRE-II are discussed. The auxiliaries, power conversion equipment, instrumentation and controls, and reactor engineering for ML-1 are detailed. A brief summary of the GTTF work is included. (For preceding period see IDO-28542.) (W.D.M.)

15454 MND-LFBR-2303

Martin Co. Nuclear Div., Baltimore.

LIQUID FLUIDIZED BED REACTOR STUDY. Quarterly Progress Report No. 1 [for] October 15, 1959 to January 31, 1960. Feb. 1960. 84p. Contract AT(30-1)-2460. OTS.

The first of four quarterly progress reports on the Liquid Fluidized Bed Reactor study program is presented. The Preliminary Hazards Report for the LFBR Critical Experiment was completed and submitted to the USAEC. The analysis of two types of critical experiments consisted of examining the effects on reactivity of placing voids in certain regions of the two types of configuration. These studies included analyses of the variations in core size, core region variations of the moderator and fuel fractions, control rods, and control modifications necessary for both types of criticals. A cost comparison of the major equipment items was performed. Preliminary effort on the critical loop included initial investigation into fuel loading

and removal requirements, vessel configurations, bed plate design and support, and system integration and transfer functions of control components. Under the abrasion studies, work was directed toward establishing the fabrication limitations of the various fuel materials and the over-all effects of the fabrication variables on the abrasion resistance of the fuel pellets. Cladding studies and mill screening tests of various pellets were initiated. The new experimental high pressure test loop was designed. (W.D.M.)

15455 MND-M-1813

Martin Co. Nuclear Div., Baltimore.

PM-1 NUCLEAR POWER PLANT PROGRAM. Quarterly Progress Report No. 2 [for] June 1 to August 31, 1959. J. S. Sieg and E. H. Smith. Oct. 5, 1959. 246p. Contract AT(30-1)-2345. OTS.

The objective of the contract is the design, development, fabrication, installation, and initial testing and operation of a prepackaged air-transportable pressurized water reactor nuclear power plant, the PM-1. The specified output is 1 Mwe and 7 million Btu/hr of heat. The plant is to be operational by March 1962. The principal efforts were completion of the plant parametric study and preparation of the preliminary design. A summary of design parameters is given. Systems development work included study and selection of packages for full-scale testing, a survey of in-core instrumentation techniques, control and instrumentation development, and development of components for the steam generator, condenser, and turbine generator, which are not commercially available. Reactor development work included completion of the parametric zero-power experiments and preparations for a flexible zero-power test program, a revision of plans for irradiation testing PM-1 fuel elements, initiation of a reactor flow test program, outlining of a heat transfer test program, completion of the seven-tube test section (SETCH-1) tests, and evaluation of control rod actuators leading to specification of a magnetic jack-type control rod drive similar to that reported in ANL-5768. Completion of the preliminary design led to initiation of the final design effort, which will be the principal activity during the next two project quarters. Preparations for core fabrication included procurement of core cladding material for the zero-power test core, arrangement with a subcontractor to convert UF_6 to UO_2 and to commence delivery of the oxide during the next quarter, development of fuel element fabrication and ultrasonic testing techniques, study of control rod materials, UO_2 recovery techniques, and boron analysis methods. Preliminary work on site preparation was pursued with receipt of USAEC approval for a location on the eastern slope of Warren Peak at Sundance, Wyoming. A survey of this site is underway. A preliminary Hazards Summary Report is in preparation. (For preceding period see MND-M-1812.) (auth)

15456 NAA-SR-3829

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

AN ADVANCED SODIUM-GRAPHITE REACTOR NUCLEAR POWER PLANT. J. R. Churchill and J. Renard. Mar. 15, 1960. 162p. Contract AT-11-1-GEN-8. OTS.

An advanced sodium-cooled, graphite-moderated nuclear power plant is described which utilizes high-pressure, high-temperature steam to generate electricity at a high thermal efficiency. Steam is generated at 2400 psig, superheated to 1050°F and, after partial expansion in the turbine, reheated to 1000°F. Net thermal efficiency of the plant is 42.3%. In a plant sized to produce a net electrical output of 256 Mw, the estimated cost is \$232/kw. Estimated cost of

power generation is 6.7 mills/kwh. In a similar plant with a net electrical output of 530 Mw, the estimated power generating cost is 5.4 mills/kwh. Most of the components of the plant are within the capability of current technology. The major exception is the fuel material, uranium carbide. Preliminary results of the development work now in progress indicate that uranium carbide would be an excellent fuel for high-temperature reactors, but temperature and burnup limitation have yet to be firmly established. Additional development work is also required on the steam generators. These are the single-barrier type similar to those which will be used in the Enrico Fermi Fast Breeder Reactor plant but produce steam at higher pressure and temperature. Questions also remain regarding the use of nitrogen as a cover gas over sodium at 1200°F and compatibility of the materials used in the primary neutron shield. All of these questions are currently under investigation. (auth)

15457 NAA-SR-4361

Atomics International Div., North American Aviation, Inc.,
Canoga Park, Calif.

PIQUA PROTOTYPE HANDLING SYSTEM. H. Nadler.
May 1, 1960. 94p. Contract AT-11-1-GEN-8. OTS.

Equipment has been developed to handle the fuel elements and control rods for the Piqua (OMR) Reactor. With the handling machine, which consists of a shielded cask mounted on a gantry, a fuel element can be replaced in the core in about 27 minutes. To shift from fuel element to control rod handling takes about 30 minutes. Functional simplicity and reliability high-light the performance of this handling system. (auth)

15458 NDA-84-15(Vols. I and II)

Nuclear Development Corp. of America, White Plains,
N. Y.

NATURAL URANIUM SODIUM-DEUTERIUM REACTORS.
(PRELIMINARY DESIGN AND ECONOMIC ANALYSIS).

L. Joseph, G. Sofer, and L. Goldstein. Feb. 28, 1959
(Vol. I) and Mar. 15, 1959 (Vol. II). 235p. Contract
AT(30-3)-256. OTS.

The results of an investigation into the economic potential of sodium-cooled, D₂O-moderated, natural uranium reactors for use in central station power plants are presented. Conclusions and recommendations, a discussion of the parametric design studies, a general design description of 200 Mw(e) plants, a discussion of the factors influencing the energy costs of the survey reactors, a description of the thermal breeder designs, a discussion of reactivity studies, and an outline of a suggested development program are included. A design description is presented of a two-region natural uranium SDR, along with several alternate core configurations and an alternate control technique. (W.D.M.)

15459 NP-8251(Amend.1)

American Electric Power Service Corp., New York and
General Nuclear Engineering Corp., Dunedin, Fla.
APPLICATION FOR USAEC LICENSES. PRELIMINARY
HAZARDS SUMMARY REPORT, FWCNG NUCLEAR
POWER PLANT. AMENDMENT NO. 1. Feb. 4, 1960.
143p. OTS.

Supplementary information to the preliminary hazards summary report of the FWCNG heavy water moderated pressure-tube reactor is presented. Items covered include hydrology, geology, meteorology, waste disposal system, control rod system, fuel element irradiation and test program, steam generator tube ruptures and CO₂-safety-valve capacities, containment vessel pressures and fuel clad temperatures, and atmospheric radioactivity. (W.D.M.)

15460 NP-8586

Thiokol Chemical Corp. Reaction Motors Div., Denville,
N. J.

NUCLEAR SPACE VEHICLES USING PEBBLE BED REACTORS. Myron M. Levoy and John J. Newgard. 1960.
13p.

For presentation at the SAE National Aeronautic Meeting, New York, N. Y., April 5-8, 1960.

Nuclear space vehicles launched from an earth orbit have little or no atmospheric contamination and in general have several advantages over nuclear rockets launched from ground. The reactor system that appears best for such vehicles is made up of a uranium-bearing graphite core with hydrogen coolant-propellant, which can furnish a specific impulse of 850 sec. This impulse requires a flow of 10 to 20 lb/sec, which means that a pebble bed reactor can be used. The design for such a reactor utilizing uranium-loaded graphite pellets is given together with the effects of its variables, e.g., variation of thickness of the BeO reflector, void fraction, and pellet thickness. Propellant pressure drops across the core are shown to be larger than for parallel plates or rods. (D.L.C.)

15461 NYO-9066

Sanderson and Porter, New York

THE PEBBLE BED REACTOR PROGRAM. Quarterly
Progress Report [for] July 1, 1959 Through September 30,
1959. [Oct. 1959]. 21p. Contract AT(30-1)-2207. OTS.

Several different types of experimental facilities were evaluated to determine the most suitable and economical means of demonstrating the technical feasibility of the PBR concept. The principal activity in primary loop decontamination was the analysis of systems for concentrating the gaseous fission products in the primary loop and the analysis of fission product removal systems and their effectiveness in holding down the primary loop activity. A nuclear model for the PBR was constructed in order to have a means of rapidly determining the effect of different design variables on reactor characteristics. Bed characteristics are discussed and model core and components are illustrated. (See also NYO-2373.) (W.D.M.)

15462 ORNL-2867

Oak Ridge National Lab., Tenn.

ENVIRONMENTAL ANALYSIS OF NS "SAVANNAH" OPERATION AT CAMDEN. W. B. Cottrell, L. A. Mann, F. L. Parker, and G. D. Schmidt. Apr. 29, 1960. 118p.

Contract W-7405-eng-26. OTS.

An analysis is presented of the accidental release of activity following the operation of the NS "Savannah" at the New York Shipbuilding Corporation docks in Camden, New Jersey. Although a number of accidents are considered, the primary concern is with the environmental activity levels and subsequent exposures which would result from the "maximum credible accident." Two variations of the MCA are considered: one in which the activity is released to the atmosphere, and another in which the vessel sinks and releases activity to the water. In the former case, due to the exceptional containment afforded by the location of the contained pressurized-water reactor system within a ventilated ship's compartment, no person would receive more than 0.3 rem total integrated exposure, and the total population exposure would be 4060 man-rems or less. The analyses of the release of activity to the Delaware River were possible because of the existence of model data on river dispersions, and they revealed that the maximum concentrations only slightly exceeded the continuous occupational exposure levels. It is concluded from these analyses that the exposures which would ensue from potential accidents following the operation of the NS "Savannah" at

Camden should not cause any undue hazard to the surrounding populace. (auth)

15463 TID-5763

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

SPECIFICATIONS FOR THE PHASE II CONSTRUCTION AND INSTALLATION OF THE ORGANIC MODERATED REACTOR EXPERIMENT, NATIONAL REACTOR TESTING STATION, IDAHO. June 4, 1956. 220p. OTS.

15464 TID-5788

Microtech Research Co., Cambridge, Mass.

CONTROL AND DYNAMICS PERFORMANCE OF A SODIUM COOLED REACTOR POWER SYSTEM. Report No. 171.

P. D. Hansen and J. H. Eaton. Dec. 28, 1959. 185p. For Alco Products, Inc. Contract AT(11-1)-666. OTS.

An analytical and analog computer study of a high performance sodium cooled reactor system was performed. As a final stage of the over-all design program conducted by ALCO Products on the intermediate heat exchanger (IHX), boiler, and superheater, Microtech Research investigated transient performance, controllability, and casualty behavior. Methods developed in an earlier study of the SM-2 System are refined, leading to a general criterion for stability of natural circulation boilers. A control scheme is devised which enables fixed parameter commercial controllers to maintain extremely tight control over the steam and sodium states despite rapid and large disturbances occurring at any load level between 15% and 100% of maximum load. A control signal propagation philosophy employing controller over-rides is developed, enabling orderly system operation following a process or control component failure, thus insuring fail-safe behavior. Results of analog computer studies of the controlled system behavior are included. The philosophies of control and analog modeling are discussed. (auth)

15465 UCRL-5906

California. Univ., Livermore. Lawrence Radiation Lab. TORY II-A INSTRUMENTATION SYSTEM. Brief Description. Charles S. Barnett, Henry C. McDonald, and Paul M. Uthe. Mar. 3, 1960. 24p. Contract W-7405-eng-48. OTS.

The Tory II-A reactor is a small, air cooled, high power-density reactor which is to operate at quite high temperatures. Design of the reactor is essentially complete. First operation is scheduled for late 1960 at the Nevada Test Site. Since the reactor is unshielded, the control room which houses the recording and indicating equipment is located approximately two miles from the test bunker. Signals from reactor and facility transducers are amplified in the test bunker and transmitted by cable to the control point. The quantities measured include neutron flux level, temperatures, pressures, vibration amplitudes, strain, and air mass flow rate. The recording and indicating system is centered around 258 channels of 1.5 cycle per second, pulse-width modulation tape recording equipment and 72 channels of 120 cps, analogue strip-chart recorders. In addition, there is a number of the usual meters, scalars, and slow-response strip-chart recorders. (auth)

15466 WAPD-MRP-85

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

PRESSURIZED WATER REACTOR (PWR) PROJECT TECHNICAL PROGRESS REPORT FOR THE PERIOD FEBRUARY 24, 1960 TO APRIL 23, 1960. 130p. Contract AT-11-1-GEN-14. OTS.

Power Plant Support. The design for installing flow measuring devices in the drains of the test, non-active,

and special waste tanks and a revised monitoring system in the effluent discharge line were completed. Work is continuing on a proprietary inhibitor for permanganate-citrate corrosion of carbon steel. Reactor Engineering. The effects of fuel conductivity and clad-fuel contact resistance on Core 2 thermal capability were analyzed. Data are included. The fuel cluster extension bracket joint test was completed; and a test report is being written. Metallurgy. No significant changes were noted in the dimensional or microstructural changes in a blanket fuel rod from a bundle of 6 E after one seed life irradiation. Structural anomalies found in defected plates from the X-3-1 experiment were attributed to exposing UO_2 to water in-pile. Data from x-ray-diffraction pattern examination of $\text{BeO}-\text{UO}_2$ fuels indicate that the BeO matrix becomes amorphous after about 10^{21} fissions/co exposure. Experiments on the release of helium from slightly irradiated B_4C at 600 to 900°C were completed. The equation for helium diffusion is $4.65 \times 10^5 \exp 72000/\text{RT}$. Physics. The effect of an inserted control rod on the timewise behavior of the water channel power peaking in a PWR-2 seed cluster was investigated. Results of an evaluation of the accuracy with which power distributions and seed blanket-power sharing values can be predicted in PWR-2 using current nuclear design techniques are included. Measurements of the ratio of epithermal to thermal neutron radiative capture of U^{238} were made in UO_2 platelets in PWR-2 geometry. The results were compared with predicted values obtained using various methods for describing the heterogeneous resonance integral and the epithermal neutron constants for compartmented fuel plates. Measurements with 6 in span control rods indicate that one rod with drawn shutdown margin is 0.7% $\Delta k/k$ greater than the value obtained with 5.2-in. rods. (J.R.D.)

15467

THE "DRAGON" PROJECT AND ITS REACTOR EXPERIMENTS. L. R. Shepherd, G. E. Lockett, R. A. U. Huddle, K. O. Hintermann, and Winfrith Heath (Organization for European Economic Co-Operation, Paris). Atomwirtschaft 5, 105-9(1960) Mar. (In German)

The Dragon project comprises a five-year research and development program which includes the construction of a reactor. The design of the reactor is based on the criteria that it should be as compact as possible (high power density) and that the gas outlet temperature should be high enough so that the use of modern efficient steam or gas turbines is possible. The physical properties of the Dragon reactor, the construction, fuel elements, and primary circuit are described. Possible future developments in the reactor design are briefly considered. (J.S.R.)

15468

THE OECC-HALDEN REACTOR PROJECT (HBWR). Heinz Braun (Institut für Atomenergi, Halden, Norway). Atomwirtschaft 5, 112-20(1960) Mar. (In German)

The Halden boiling water reactor went critical on June 29, 1959. The reactor is fueled with natural uranium spiked in 1.5% enriched UO_2 . It is cooled and moderated by D_2O . A technical description of the reactor plant is given, and its research program is surveyed. The organization of this international project is briefly outlined. (J.S.R.)

15469

FUEL ELEMENTS FOR SHIP REACTORS. THE ECONOMIC SOLUTION OF NEW NUCLEAR TECHNOLOGICAL PROBLEMS. A. Boettcher (Deutsche Gold- und Silberscheidentalt vormals Roesler, Frankfurt am Main). Atomwirtschaft 5, 157-8(1960) Apr. (In German)

Although various solutions in the development of fuel elements for ship reactors can be proposed, the final choice of a fuel element must be determined by the economics of the fuel cycle. A decrease in cost is possible by the coordination of several reactor projects if the processed fuel of one reactor can be used in another reactor with lower enrichment. (J.S.R.)

15470

GRAPHITE FOR HIGH TEMPERATURE REACTORS. H. W. Schmidt. *Atomwirtschaft* 5, 181-2(1960) Apr. (In German)

The graphite problems of the Dragon project and the experimental results obtained to date are described. A graphite of low permeability, negligible corrosive action, and high density is required. At the present time liquid impregnation with furfuryl alcohol is used to obtain the graphite. Permeabilities of 10^{-8} cm²/sec are obtained for the final product. (J.S.R.)

15471

NUCLEAR REACTORS FOR THE PRODUCTION OF ELECTRICAL ENERGY. Ernesto Grossman. *Bol. inform. cient. nacil.* No. 82, 134-53(1957) June-Sept. (In Spanish)

A survey is given of the production of electrical energy by nuclear reactors. The basic fundamentals of fission and fusion reactions are first reviewed. Then the elements of a reactor are described. The principal types of reactors are discussed, and nuclear power stations are considered. The reserves of nuclear fuels are then briefly discussed. (J.S.R.)

15472

NUCLEAR ROCKET ENGINE CONTROLS IN AN ORBITAL TRANSFER ROLE. B. P. Helgeson (Thiokol Chemical Corp., Denville, N. J.). *IRE Trans. Nuclear Sci.* NS-7, 29-35(1960) Mar.

It is assumed that the mission for a nuclear rocket upper-stage vehicle is the transfer from a 300-mile earth orbit to a corotational earth orbit at 19,400 miles. An engine of the solid fuel, heat exchanger type is assumed and briefly described. The engine duty cycle requirements are deduced from the incremental velocity requirements of the mission. Controls attention is fixed on the thrust programmer without discussion of the equally important sequence control aspects. A constant specific impulse, variable thrust controls approach is taken. Basic principles underlying this approach are discussed. Fineness of control and restart capability are pointed out as inherent features of the engine. These augment the well-known performance advantages due to the high specific impulse of nuclear rocket engines. (auth)

15473

A METHOD OF ANALYSIS ON REACTOR SPATIAL KINETICS ON CALDER HALL TYPE REACTOR. A. Takeda (Japan Atomic Power Co.). *J. Atomic Energy Soc. Japan* 2, 175-81(1960). (In Japanese)

In the core of a large power reactor the neutron flux shape tends to be distorted in transient behavior. Especially in cores with positive temperature coefficient, such as the improved Calder Hall type reactor, the distortion becomes unstable, resulting in divergence or oscillation. In order to control such a reactor a spatial control system should be provided such that control rods are locally divided into several groups and each group of control rods is independently moved to control local reactivity. Kinetic analysis of such a reactor requires a method which can describe the time behavior of neutron flux shape and temperature distribution in the core. A

new method using the mode transfer functions, corresponding to spatial eigenfunctions, is proposed. Applying this method the spatial kinetic analysis can be resolved into each mode kinetic analysis without any spatial consideration. (auth)

15474

THE CHOICE OF THE MOST CONVENIENT THERMAL CYCLE OF THE FIRST CZECHOSLOVAK NUCLEAR POWER STATION. Lev Samoilovich Sterman and Ladislav Bohal (Moskevsky Energeticky Institut, Prague). *Jaderna energie* 6, 110-15(1960). (In Czech)

Basic problems in determining the optimum thermal cycle for a gas-cooled nuclear power station are discussed. A method for the determination is developed and applied to the first Czechoslovak nuclear power station. The performance of the station with and without regenerative heating is compared. (D.E.B.)

15475

A GENERAL PROPERTY OF BOUNDEDNESS FOR THE POWER OF SOME STABLE AND UNSTABLE NUCLEAR REACTORS. Henri B. Smets. *Nukleonik* 2, 44-5(1960) Apr. (In English)

If the reactivity k of a nuclear reactor is a linear functional of the power n : $k = -\int_0^\infty K(u)[n(t-u) - n_0] du$, it is shown that the power remains bounded for all initial conditions when the kernel $K(u)$ is non-negative. The value of the upper bound of the power is derived in the case of fast transients. (auth)

15476

NUCLEAR REACTOR WITH GAS COOLING. (to Brown, Boveri and Cie Aktiengesellschaft). British Patent 834,978. May 18, 1960.

A pellet bed nuclear reactor is briefly described. The molded pellets are 3-cm spheres, gas-cooled, and are circulated through the core continuously. (T.R.H.)

Research Reactors

15477 AERE-M-578

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

NEUTRON FLUX MEASUREMENT IN THE BEAM HOLE ON LIDO. J. M. Ponce de Leon and C. J. Kenward. Jan. 1960. 9p.

The thermal, epithermal, and fast neutron fluxes were measured in the central beam hole of LIDO by foil activation techniques and cadmium ratio determinations. (C.J.G.)

15478 CF-60-4-35

Oak Ridge National Lab., Tenn.

CALCULATED REACTIVITY CHANGES PRODUCED BY THE OSCILLATION OF AN EPITHERMAL NEUTRON ABSORBER IN THE BULK SHIELDING REACTOR. R. Perez-Belles. Apr. 1, 1960. 14p. OTS.

An attempt is made to ascertain the optimum working conditions of a pile oscillator and to compare this method with the danger coefficient technique from the point of view of minimum amount of resonance absorption which can be detected. The space-time behavior of the absorption properties of the sample is described by means of a δ -function and the reactor kinetic equations are obtained by using a single mode expansion of the flux. The results are applied to a bare reactor model equivalent to the fully reflected, parallelepiped BSR-I. (W.D.M.)

15479 CF-60-4-89

Oak Ridge National Lab., Tenn.

STANDARD OPERATING PROCEDURE FOR TSR-II.

J. S. Lewin. Apr. 20, 1960. 19p. OTS.

The daily check list, the startup procedure both for in-pool and in-air operation, and the normal shutdown procedure for the Tower Shielding Reactor-II are outlined. The sequence of events which leads to each annunciator warning and the automatic corrective action which is then initiated by the control circuits are described. (auth)

15480 HMI-B9

Hahn-Meitner-Institut für Kernforschung Berlin.

REAKTIVITÄTSMESSUNGEN AM BER. (Reactivity Measurements on BER). J. R. Engel and R. Schröder. Feb. 1960. 37p.

A parameter study under various conditions of fuel concentration and solution volume was carried out on the BER. The dependent variables examined were excess reactivity, water-, fuel solution-, and fuel mass coefficients, control rod worth, temperature coefficient and poisoning factors (danger coefficients) for several materials. The results are presented in tabular and graphic form. (auth)

15481 HMI-B10

Hahn-Meitner-Institut für Kernforschung Berlin.

BERECHNUNG DER REAKTIVITÄT UND KRITISCHEN MENGE DES "BER." (Calculation of Reactivity and Critical Mass of BER). H. Gaus. Mar. 1960. 30p.

For the present fuel of the reactor the reproduction factor is $k = 1.448$. This value implies the fast fission factor from U-238 $\epsilon(238) \approx 1.002$. The partition of the U-235-fission in thermal and intermediate (above 0.1 eV) fissions is given by $k/\epsilon(238) = 1.343 + 0.102$. The resonance escape probability is $p(238) = 0.950$. A two-group calculation yields the material buckling $B_m^2 = 0.00720 \text{ cm}^{-2}$, and for the completely filled core the geometrical buckling $B^2 = 0.00621 \text{ cm}^{-2}$, which gives 4.3% reactivity. For a partly filled core a simple approximation with surface to volume factor gives as critical loading 23.44 liters (experimental value 23.05 liters) and for 26.22 liters loading the reactivity 2.0% (experimental value 3.3%). The neutron leakage from the core is restricted to the fast group only the reflector being a source for the thermal neutrons due to the relatively small dimensions of the core. (auth)

15482 ORNL-2897

Oak Ridge National Lab., Tenn.

FISSION PRODUCT DISTRIBUTION IN ORR FUEL ELEMENTS. A. L. Colomb. May 19, 1960. 8p. Contract W-7405-eng-26. OTS.

The gamma rays emitted by ORR fuel elements and by the fuel section of shim rods are measured as a function of position along the elements with a very small graphite ionization chamber. Comparison of the fuel burnup calculated from the gamma measurements and by the flux-time method shows good agreement. This means that the gamma-ray distribution measurements could be a good method of determining the U^{235} consumption in fuel elements. Distributions of the macroscopic absorption cross section and the infinite multiplication factor along fuel elements are computed from the gamma dose rate distribution. The limited usefulness of the shim rod fuel section is discussed in the last section. (auth)

15483

THE THERMAL NEUTRON SPECTRUM OF THE EXPERI-

MENTAL REACTOR OF THE INSTITUTE OF ATOMIC PHYSICS OF THE RUMANIAN ACADEMY. H. Teutsch, S. Apostolescu, and P. Timiş. Acad. rep. populare Romîne, Inst. fiz. atomică şi Inst. fiz. Studii cercetări fiz. 10, 465-72(1960). (In Rumanian)

By means of a thermal neutron spectrometer, based on the time-of-flight method, the thermal neutron spectrum in a horizontal canal of the VVR-S reactor was determined. The distribution obtained is given, with a good approximation, by a Maxwell function of the form $F(t) = \text{const.} \times t^{-4} \exp^{-(t_0/t)^2}$, where t is the time of flight of the neutron, and $t_0 = 1481 \mu\text{sec}$, which corresponds to a neutron temperature of $390 \pm 17^\circ\text{K}$. During the determination the moderator temperature at the interior of the reactor was 297°K . An absolute method for the determination of the origin of the time scale is also described. (tr-auth)

15484

THE EXPERIMENTAL DETERMINATION OF THE BUCKLING IN THE BARE HEAVY WATER NATURAL URANIUM CRITICAL ASSEMBLY "RB." Nenad M. Raišić, Dragoslav D. Popović, Stevan M. Takač, and Magdalena M. Dordević. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade) 10, 1-6(1960) Mar. (In English)

The buckling of the heavy water natural uranium critical assembly was determined by measuring the thermal neutron flux distribution. The obtained value for the critical buckling at the temperature of 20°C is: $B^2 = (8.516 \pm 0.02) \text{ m}^{-2}$. The possible systematic error was estimated as 0.1 m^{-2} . (auth)

15485

THE THERMAL NEUTRON SPECTRUM IN THE WWR-S REACTOR, BUCHAREST. H. Teutsch, S. Apostolescu, and P. Timiş (Institut für Atomphysik, Bucharest). Nukleonik 2, 41-3(1960) Apr. (In German)

With the help of a time-of-flight spectrometer, the thermal neutron spectrum of a horizontal canal of the WWR-S Reactor was determined. The measured distribution corresponds to a Maxwell function of the form $F(t) = at^{-4} \exp^{-(t_0/t)^2}$, in which t represents the neutron time of flight and $t_0 = 1481 \pm 32 \mu\text{sec}$. This corresponds to a neutron temperature $T = 390 \pm 17^\circ\text{K}$. The moderator temperature during the research was 297°K . An absolute method for the determination of the starting time was described. (tr-auth)

WASTE DISPOSAL AND PROCESSING

15486 HW-59658

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

HEAT TRANSFER STUDY FOR SELF-BOILING RADIOACTIVE WASTES. H. W. Stivers and G. R. Taylor. Apr. 27, 1959. 24p. OTS.

A study was conducted to determine the effects of heat transfer parameters on the thermal gradient across the side wall of storage tanks as a function of stored waste temperature rise rate. Data are included which may be used to define the approximate temperature gradients which would exist across the wall of Redox and Purex type storage tanks for either uniform or incremental rates of temperature rise when the tank contents are heated from about 70 to 230°F . (J.R.D.)

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